

H00631A

(19)日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11)特許出願公開番号

特開2001-346769

(P2001-346769A)

(43)公開日 平成13年12月18日 (2001.12.18)

(51)Int.Cl. ⁷	識別記号	F I	テーマコード (参考)
A 6 1 B	5/022	A 6 1 B 5/02	3 3 7 L 4 C 0 1 7
	5/0205		E 4 C 0 2 7
	5/0245		3 1 0 A
	5/0402		3 3 7 E
		5/04	3 1 0 M
審査請求 未請求 請求項の数 4 O L (全 16 頁)			

(21)出願番号 特願2000-173700(P2000-173700)

(22)出願日 平成12年6月9日(2000.6.9)

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Fターム(参考) 4C017 AA02 AA08 AA10 AC03 AC16

AC26 AD01 BD01 BD06 CC01

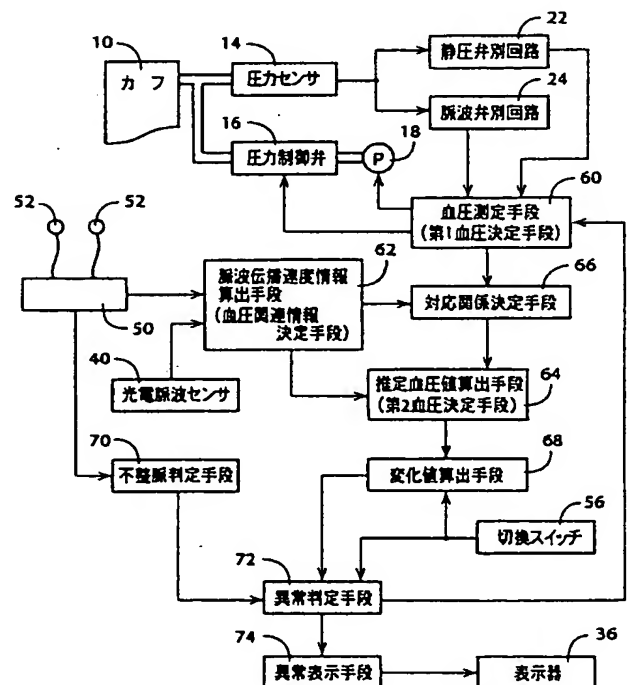
4C027 AA02 BB05 GG16

(54)【発明の名称】 循環状態監視装置

(57)【要約】

【目的】 正確に患者の循環状態を判定することができる循環状態監視装置を提供する。

【解決手段】 変化値算出手段68により、推定血圧値算出手段64によって算出された推定血圧値E B Pの変化値 Δ E B Pを算出し、異常判定手段72では、不整脈判定手段70によって不整脈が発生したと判定され、且つ、変化値算出手段68により算出された変化値 Δ E B Pが予め設定された判定基準値T H (Δ)を越えた場合に循環状態が異常であると判定する。すなわち、不整脈および血圧の変化に基づいて循環状態の異常を判定するので、正確に循環状態を判定することができる。



前記生体の所定部位に巻回されるカフを用い、該カフの

【従来の技術】患者に心拍同期波検出装置を装着し、その心拍同期波検出装置により検出される心拍同期波に基

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づいて生体の不整脈の発生を判定し、不整脈が発生したと判定した場合には、アラームを発生する循環状態監視装置が知られている。たとえば、心拍同期波として心電誘導波形を検出するために、心電信検出装置（心拍同期波検出装置）に備えられた複数の電極を生体の所定部位に装着し、その心電信検出装置により測定された心電図に基づいて不整脈を自動的に診断し、不整脈が発生したと判定した場合には、アラームを発生する装置が知られている。

【0003】不整脈は、患者の循環状態の悪化を表すことがあるため、不整脈が発生した場合には、アラームを発生するようにされているのである。しかし、不整脈は必ずしも患者の循環状態の悪化を表さない場合もあるので、不整脈のみによりアラームを発生させると、患者の循環状態が悪化していないにもかかわらずアラームが発生してしまう場合がある。また、アラームが発生しても患者の循環状態が悪化していない場合が頻繁に発生すると、医療現場ではアラームを切ってしまうこともある。しかし、患者の循環状態の悪化に基づいて不整脈が発生していることもあるので、アラームを切ることは好ましくない。

【0004】

【発明が解決しようとする課題】ところで、血圧を監視することによっても患者の循環状態は監視できる。そこで、不整脈の発生を連続的に監視し、不整脈が発生した場合には、自動的に血圧を測定する自動血圧監視装置が提案されている。たとえば、実開昭64-56206号公報に記載された自動血圧測定装置がそれである。この自動血圧測定装置によれば、不整脈が発生したと判定された場合に血圧値が自動的に測定され、その血圧値が予め定められた範囲内にあるか否かが判断される。すなわち、不整脈および血圧値に基づいて患者の循環状態を判定することができるので、比較的正確に患者の循環状態が判定できる。

【0005】しかし、不整脈が発生している場合には、不整脈が発生していない場合に正常範囲とされる血圧値であっても、緊急の処置を必要とする場合がある。すなわち、上記公報に記載された自動血圧測定装置では異常と判定されない場合であっても、実際には、循環状態が異常であり、緊急の処置を必要とする場合があり、上記公報に記載された自動血圧測定装置では、患者の循環状態の判定精度が不十分であった。

【0006】本発明は以上のような事情を背景として為されたものであり、その目的とするところは、正確に患者の循環状態を判定することができる循環状態監視装置を提供することにある。

【0007】

【課題を解決するための手段】上記目的を達成するために種々検討を重ねた結果、循環状態の異常に基づいて不整脈が発生している場合には、血圧の変化が大きいこと

に着目し、不整脈が発生している場合には、血圧が異常値になっていなくてもその血圧の変化が大きい場合には循環状態が異常であると判定すれば、より正確に循環状態の異常を判定できることを見いだした。また、不整脈が発生している場合には、血圧異常を判定する基準値を不整脈が発生しないときよりも正常値側に設定することによっても、正確に循環状態の異常を判定できることを見いだした。

【0008】

10 【課題を解決するための第1の手段】すなわち、上記目的を達成するための第1発明の要旨とするところは、生体に装着されてその生体の心拍同期波を検出する心拍同期波検出装置と、その心拍同期波検出装置により検出された心拍同期波に基づいて不整脈を判定する不整脈判定手段とを備え、生体内を血液が循環する状態を監視する循環状態監視装置であって、(a) 前記生体の所定部位に巻回されるカフによりその部位を止血し、続いてそのカフの圧迫圧力を徐速降圧させる過程で発生する脈波に基づいて、その生体の第1血圧値を決定する第1血圧決定手段と、(b) 前記生体の所定部位に装着される脈波検出装置によりその部位を止血することなく検出される脈波に基づいて、前記生体の血圧に関連して変動する血圧関連情報を逐次決定する血圧関連情報決定手段と、(c) その血圧関連情報決定手段により逐次決定された血圧関連情報と前記第1血圧決定手段により決定された第1血圧値との間の対応関係を決定する対応関係決定手段と、(d) その対応関係決定手段により決定された対応関係を用い、前記血圧関連情報決定手段により逐次決定された血圧関連情報に基づいて、前記生体の第2血圧値を逐次決定する第2血圧決定手段と、(e) その第2血圧決定手段により決定された第2血圧値の変化値を逐次算出する変化値算出手段と、(f) 前記不整脈判定手段により不整脈が発生したと判定され、且つ、前記変化値算出手段により算出された変化値が予め設定された判定基準値を越えたことに基づいて、前記生体の循環状態が異常であると判定する異常判定手段とを、含むことにある。

【0009】

40 【第1発明の効果】このようにすれば、変化値算出手段により、第2血圧決定手段によって決定された第2血圧値の変化値が算出され、異常判定手段により、不整脈判定手段によって不整脈が発生したと判定され、且つ、変化値算出手段により算出された変化値が予め設定された判定基準値を越えたことに基づいて循環状態が異常であると判定されるので、正確に循環状態が判定される。加えて、血圧関連情報は脈波検出装置により生体を止血することなく検出された脈波に基づいて決定され、第2血圧値はその血圧関連情報に基づいて決定されるので、不整脈が発生したと判定される毎に生体の一部を止血して患者に苦痛を与えるという不都合がない。

【0010】

【第1発明の他の態様】ここで、好適には、前記循環状態監視装置は、低血圧患者であることを表す低血圧患者信号を入力する入力装置をさらに備え、前記入力装置からその低血圧患者信号が入力された場合には、前記異常判定手段は、前記不整脈判定手段により不整脈が発生したと判定され、且つ、上記変化値算出手段により算出された変化値および前記第2血圧決定手段により決定された第2血圧値の少なくとも一方が予めそれぞれについて設定された判定基準値を越えたことに基づいて、前記生体の循環状態が異常であると判定するものである。低血圧患者は正常な状態でも血圧が低いので、血圧の変化がそれほど大きくなくても、緊急の処置を必要とするほどに血圧が低下している場合があるが、このようにすれば、入力装置から予め低血圧患者信号を入力しておく、不整脈が発生したと判定された場合には、異常判定手段により、変化値算出手段によって算出された変化値および第2血圧値決定手段により決定された第2血圧値の少なくとも一方が予めそれぞれについて設定された判定基準値を越えたことに基づいて、循環状態が異常であると判定されるので、低血圧患者であっても、確実に循環状態の異常が判定される。

【0011】

【課題を解決するための第2の手段】また、前記目的を達成するための第2発明の要旨とするところは、生体に装着されてその生体の心拍同期波を検出する心拍同期波検出装置と、その心拍同期波検出装置により検出された心拍同期波に基づいて不整脈を判定する不整脈判定手段とを備え、前記生体内を血液が循環する状態を監視する循環状態監視装置であって、(a) 前記生体の所定部位に巻回されるカフを用い、そのカフの圧迫圧力の変化過程で発生する脈波に基づいて、その生体の血圧値を測定する血圧測定手段と、(b) その血圧測定手段により決定された血圧値の変化値を逐次算出する変化値算出手段と、(c) 前記不整脈判定手段により不整脈が発生したと判定された場合に、前記血圧測定手段および前記変化値算出手段を実行し、その変化値算出手段により算出された変化値が予め設定された判定基準値を越えたことに基づいて、前記生体の循環状態が異常であると判定する異常判定手段とを、含むことにある。

【0012】

【第2発明の効果】このようにすれば、異常判定手段により、不整脈判定手段によって不整脈が発生したと判定された場合には、血圧測定手段により血圧値が測定され、変化値算出手段によりその血圧値の変化値が算出され、さらに、その変化値が予め設定された判定基準値を越えたことに基づいて循環状態が異常であると判定される。すなわち、不整脈と血圧の変化とに基づいて生体の循環状態の異常が判定されるので、正確に循環状態が判定される。

【0013】

【第2発明の他の態様】ここで、好適には、前記循環状態監視装置は、低血圧患者であることを表す低血圧患者信号を入力する入力装置をさらに備え、前記入力装置からその低血圧患者信号が入力された場合には、前記異常判定手段は、前記不整脈判定手段により不整脈が発生したと判定された場合に、前記血圧測定手段および上記変化値算出手段を実行し、その変化値算出手段により算出された変化値およびその血圧測定手段により測定された血圧値の少なくとも一方が予めそれぞれについて設定された判定基準値を越えたことに基づいて、前記生体の循環状態が異常であると判定するものである。このようにすれば、入力装置から予め低血圧患者信号を入力しておく、不整脈が発生したと判定された場合には、異常判定手段により、変化値算出手段によって算出された変化値および血圧測定手段によって測定された血圧値の少なくとも一方が予めそれぞれについて設定された判定基準値を越えたことに基づいて、循環状態が異常であると判定されるので、より確実に循環状態の異常が判定される。

【0014】

【課題を解決するための第3の手段】また、前記目的を達成するための第3発明の要旨とするところは、生体に装着されてその生体の心拍同期波を検出する心拍同期波検出装置と、その心拍同期波検出装置により検出された心拍同期波に基づいて不整脈を判定する不整脈判定手段と、生体内を血液が循環する状態を監視する循環状態監視装置であって、(a) 前記生体の所定部位に巻回されるカフを用い、そのカフの圧迫圧力の変化過程で発生する脈波に基づいて、その生体の血圧値を測定する血圧測定手段と、(b) その血圧測定手段により決定された血圧値が予め設定された第1基準血圧値以下であることに基づいて前記生体の循環状態が異常であると判定する第1異常判定手段と、(c) 前記不整脈判定手段により不整脈が発生したと判定された場合に、前記血圧測定手段を実行し、その血圧測定手段により決定された血圧値が前記第1基準血圧値よりも大きい値に予め設定された第2基準血圧値以下であることに基づいて、前記生体の循環状態が異常であると判定する第2異常判定手段とを、含むことにある。

【0015】

【第3発明の効果】このようにすれば、第1異常判定手段により、血圧測定手段によって測定された血圧値が予め設定された第1基準血圧値以下であることに基づいて生体の循環状態の異常が判定される。また、第1異常判定手段により循環状態の異常が判定されない場合にも、第2異常判定手段により、不整脈判定手段によって不整脈が発生したと判定された場合には、血圧測定手段により血圧値が測定され、その血圧値が前記第1基準血圧値よりも大きい値に予め設定された第2基準血圧値以下であることに基づいて生体の循環状態の異常が判定される

ので、正確に循環状態の異常が判定される。

【0016】

【課題を解決するための第4の手段】また、前記目的を達成するための第4発明の要旨とするところは、前記生体に装着されてその生体の心拍同期波を検出する心拍同期波検出装置と、その心拍同期波検出装置により検出された心拍同期波に基づいて不整脈を判定する不整脈判定手段とを備え、生体内を血液が循環する状態を監視する循環状態監視装置であって、(a) 前記生体の所定部位に巻回されるカフによりその部位を止血し、続いてそのカフの圧迫圧力を徐速降圧させる過程で発生する脈波に基づいて、その生体の第1血圧値を決定する第1血圧決定手段と、(b) 前記生体の所定部位に装着される脈波検出装置によりその部位を止血することなく検出される脈波に基づいて、前記生体の血圧に関連して変動する血圧関連情報を逐次決定する血圧関連情報決定手段と、(c) その血圧関連情報決定手段により逐次決定された血圧関連情報と前記第1血圧決定手段により決定された第1血圧値との間の対応関係を決定する対応関係決定手段と、(d) その対応関係決定手段により決定された対応関係を用い、前記血圧関連情報決定手段により逐次決定された血圧関連情報に基づいて、前記生体の第2血圧値を逐次決定する第2血圧決定手段と、(e) その第2血圧決定手段により決定された第2血圧値が予め設定された第1基準血圧値以下であることに基いて前記生体の循環状態が異常であると判定する第1異常判定手段と、(f) 前記不整脈判定手段により不整脈が発生したと判定され、且つ、前記第2血圧決定手段により決定された第2血圧値が前記第1基準血圧値よりも大きい値に予め設定された第2基準血圧値以下であることに基いて、前記生体の循環状態が異常であると判定する第2異常判定手段とを、含むことにある。

【0017】

【第4発明の効果】このようにすれば、第1異常判定手段により、第1血圧決定手段により決定された第1血圧値が予め設定された第1基準血圧値以下であることに基いて生体の循環状態の異常が判定される。また、第1異常判定手段により循環状態の異常が判定されない場合にも、第2異常判定手段により、不整脈判定手段によって不整脈が発生したと判定され、且つ、第2血圧決定手段により決定された第2血圧値が前記第1基準血圧値よりも大きい値に予め設定された第2基準血圧値以下であることに基いて循環状態が異常であると判定されるので、正確に循環状態が判定される。加えて、血圧関連情報は、脈波検出装置により生体を止血することなく検出された脈波に基づいて決定され、第2血圧値は、その血圧関連情報に基づいて決定されるので、不整脈が発生したと判定される毎に生体の一部を止血して患者に苦痛を与えるという不都合が解消される。

【0018】

【発明の他の態様】ここで、好適には、前記第1発明乃至第4発明にかかる循環状態監視装置において、前記心拍同期波検出装置は、前記生体の所定部位に装着される複数の電極を備え、その電極を通して心電誘導信号を検出する心電信号検出装置である。このようにすれば、心電信号検出装置により検出される心電誘導信号は所謂心電図であり、不整脈判定手段では、その心電図に基づいて不整脈が判定されるので、様々な種類の不整脈を判定することができる。

10 【0019】また、好適には、前記第1発明乃至第4発明にかかる循環状態監視装置において、前記心拍同期波検出装置は、前記カフを含み、そのカフの圧迫圧力を最低血圧値よりも十分に低い予め設定された圧迫圧力としたときに、そのカフ内に発生する心拍同期波を検出するものである。このようにすれば、血圧測定のためのカフを用いて心拍同期波を検出するので、循環状態監視装置は構成が簡単になり、且つ、安価になる。

【0020】

20 【発明の好適な実施の形態】以下、本発明の実施の形態を図面に基づいて詳細に説明する。図1は本発明が適用された循環状態監視装置8の構成を説明するブロック線図である。

30 【0021】図1において、循環状態監視装置8は、ゴム製袋を布製帯状袋内に有してたとえば患者の上腕部12に巻回されるカフ10と、このカフ10に配管20を介してそれぞれ接続された圧力センサ14、圧力制御弁16、および空気ポンプ18とを備えている。上記圧力制御弁16は、カフ12内への圧力の供給を許容する圧力供給状態、カフ12内を徐々に排圧する徐速排圧状態、およびカフ12内を急速に排圧する急速排圧状態の3つの状態に切り換えられるように構成されている。

【0022】圧力センサ14は、カフ10内の圧力を検出してその圧力を表す圧力信号SPを静圧弁別回路22および脈波弁別回路24にそれぞれ供給する。静圧弁別回路22はローパスフィルタを備え、圧力信号SPに含まれる定常的な圧力すなわちカフ圧P_cを表すカフ圧信号SKを弁別してそのカフ圧信号SKをA/D変換器26を介して電子制御装置28へ供給する。

40 【0023】上記脈波弁別回路24はバンドパスフィルタを備え、圧力信号SPの振動成分であるカフ脈波信号SM_iを周波数的に弁別してそのカフ脈波信号SM_iをA/D変換器29を介して電子制御装置28へ供給する。このカフ脈波信号SM_iが表すカフ脈波は、患者の心拍に同期して図示しない上腕動脈から発生してカフ10に伝達される上腕動脈波である。

50 【0024】上記電子制御装置28は、CPU30、ROM32、RAM34、および図示しないI/Oポート等を備えた所謂マイクロコンピュータにて構成されており、CPU30は、ROM32に予め記憶されたプログラムに従ってRAM34の記憶機能を利用しつつ信号処

理を実行することにより、患者の循環状態を判定するとともに、表示器36の表示内容を制御する。

【0025】容積脈波検出装置として機能する光電脈波センサ40は、生体の末梢血管の容積脈波（プレシモグラフ）を検出するものであり、たとえば、カフ10が巻回されていない側の腕の指尖部に装着される。この光電脈波センサ40は、脈拍検出などに用いるものと同様に構成され、指尖部などの生体の一部を収容可能なハウジング42内に、ヘモグロビンによって反射可能な波長帯の赤色光或いは赤外光、好ましくは酸素飽和度によって影響を受けない800nm程度の波長、を生体の表皮に向かって照射する光源である発光素子44と、ハウジング42の発光素子44に対向する側に設けられ、上記生体の一部を透過してきた光を検出する受光素子46とを備え、毛細血管内の血液容積に対応する光電脈波信号SM₂を出力し、A/D変換器48を介して電子制御装置28へ供給する。

【0026】心電信号検出装置50は、生体の所定の部位に貼り着けられる複数の電極52を備え、その電極52を介して心筋の活動電位を示す心電誘導波、所謂心電図を連続的に検出し、その心電誘導波を示す心電誘導信号SEをA/D変換器54を介して前記電子制御装置28へ供給する。上記心電誘導波は、心拍に同期して発生する心拍同期波であることから、心電信号検出装置50は心拍同期波検出装置として機能する。

【0027】切り換えスイッチ56は、本実施例において入力装置として機能するものであり、患者が低血圧患者であることを表す低血圧患者信号を出力する位置と、患者が低血圧患者でないことを表す信号を出力する位置の2つの位置に切り換え可能に構成されている。この切り換えスイッチ56は、医者等の判断により、患者が低血圧患者であると判断された場合に、循環状態の監視に先立って予め切り換え操作されるが、患者が低血圧患者でない場合にも、この切り換えスイッチ56が低血圧患者信号を出力する位置に位置させられても差し支えない。なお、低血圧患者とは、健康な状態でも最高血圧値が低く、たとえば、最高血圧値が100mmHg以下である患者を指す。

【0028】図2は、上記電子制御装置28の制御機能の要部を説明する機能ブロック線図である。図において、血圧測定手段60は第1血圧決定手段としても機能するものであり、まず、空気ポンプ18を駆動させ、且つ、圧力制御弁16を圧力供給状態に切替えることによりカフ12内の圧力を急速昇圧させる。そして、静圧弁別回路22により弁別されるカフ圧信号SKに基づいてカフ12の圧迫圧力を最高血圧値よりも高い所定の目標圧力値P_{cu}（たとえば、180mmHg程度の圧力値）に到達したと判定した場合、続いて圧力制御弁16を徐速排圧状態に切り替えることにより、カフ12の圧迫圧力を3mmHg/sec程度に予め設定された速度で徐速降圧さ

せ、その徐速降圧過程において順次採取されるカフ脈波信号SM₁が表す脈波の振幅の変化に基づきよく知られたオシロメトリック法を用いて、最高血圧値BP_{SYS}、平均血圧値BP_{MEAN}および最低血圧値BP_{DIA}などを決定する。

【0029】脈波伝播速度情報算出手段62は、図3に示すように心電信号検出装置50により逐次検出される心電誘導波の周期毎に発生する所定の部位たとえばR波から、光電脈波センサ40により逐次検出される光電脈波の周期毎に発生する所定の部位たとえば立ち上がり点或いは下ピーク点までの時間差（脈波伝播時間）DT_{rr}を逐次算出する時間差算出手段を備え、その時間差算出手段により逐次算出される時間差DT_{rr}に基づいて、予め記憶される式1から、被測定者の動脈内を伝播する脈波の伝播速度PWV（m/sec）を逐次算出する。これら脈波伝播時間DTまたは脈波伝播速度PWVは、生体の血圧に関連して変動することが知られている。すなわち、脈波伝播速度情報は血圧関連情報であり、脈波伝播速度情報算出手段62は血圧関連情報決定手段として機能する。尚、式1において、L（m）は左心室から大動脈を経て前記光電脈波センサ40が装着される部位までの距離であり、T_{rr}（sec）は心電誘導波形のR波から大動脈起始部脈波の下ピーク点までの前駆出期間である。これらの距離Lおよび前駆出期間T_{rr}は定数であり、予め実験に基づいて求められた値が用いられる。

$$(式1) \quad V_w = L / (DT_{rr} - T_{rr})$$

【0030】第2血圧決定手段として機能する推定血圧値算出手段64は、予め決定された脈波伝播速度情報と推定血圧値EBPとの対応関係式、たとえば式2または式3に示される対応関係式を用いて、脈波伝播速度情報算出手段62により実際に逐次算出される脈波伝播時間DT_{rr}または脈波伝播速度PWV等の脈波伝播速度情報に基づいて推定血圧値EBPを逐次算出し、その算出した推定血圧値EBPをRAM34の図示しない記憶領域に順次記憶する。なお、式2および式3において、 α 、 α' 、 β 、 β' は定数であり、血圧が高くなるほど脈波伝播時間DT_{rr}は小さくなる（すなわち1/DT_{rr}は大きくなる）ので、定数 α は正の値となり、血圧が高くなるほど脈波伝播速度PWVは大きくなるので、定数 α' は正の値となる。

$$(式2) \quad EBP = \alpha (1/DT_{rr}) + \beta$$

$$(式3) \quad EBP = \alpha' PWV + \beta'$$

【0031】対応関係決定手段66は、血圧測定手段60により測定された最高血圧値BP_{SYS}と、その血圧測定時（すなわち血圧測定期間内またはその血圧測定期間の直前若しくは直後）における脈波伝播速度情報とに基づいて、上記対応関係式の定数を決定する。たとえば、血圧測定期間内において、脈波伝播速度情報算出手段62により算出された脈波伝播時間DT_{rr}に基づいて、上記式2に示される予め設定された関係の定数を決定す

る。この場合の定数決定の方法は、たとえば、血压測定手段60により測定された最高血压値 BP_{SYS} と上記血压測定時に算出された脈波伝播時間 DT_{tr} とを用いて、上記式2の定数 α および β の何れか一方を予め決定(変更)する。または、血压測定手段60により測定された最高血压値 BP_{SYS} と上記血压測定時に算出された脈波伝播時間 DT_{tr} を一組とし、前回の血压測定時に得られた最高血压値 BP_{SYS} と脈波伝播時間 DT_{tr} をもう一組として、その二組の関係を満たすように定数 α および β を予め決定する。なお、上記最高血压値 BP_{SYS} に代えて、血压測定手段60により測定された平均血压値 BP_{MEAN} 或いは最低血压値 BP_{DIA} が用いられてもよい。要するに推定血压値 EBP を最高血压値とするか、平均血压値とするか、最低血压値とするかによって選択される。

【0032】変化値算出手段68は、推定血压値算出手段64により逐次算出された推定血压値 EBP の変化値 ΔEBP を算出する。ここで、変化値 ΔEBP とは、逐次算出される推定血压値 EBP の変化率(%)または変化量(mmHg)であり、たとえば推定血压値 EBP の所定拍数間(たとえば20拍乃至30拍程度)或いは所定時間(30秒乃至数分程度)の移動平均 EBP_{AV} に対する変化率または変化量、または、前回血压測定手段60により血压測定が実行されたときの推定血压値 EBP 、或いは所定時間前(たとえば10分前)若しくは所定拍数前の推定血压値 EBP に対する変化率または変化量である。

【0033】不整脈判定手段70は、心電信号検出装置50から供給される心電誘導信号 SE に基づいてよく知られた不整脈判定アルゴリズムに従って、不整脈の発生を判定する。上記不整脈判定アルゴリズムは、たとえば、心電誘導信号 SE が表す心電誘導波形と予め記憶された正常時の心電誘導波形の形状とを比較して判定し、検出された心電誘導波形中の $S-T$ 区間の平坦部($S-T$ レベル)が上昇または下降して上記正常時の形状と一定範囲を越えて異なる場合や、心室性期外収縮が発生した場合に不整脈が発生したと判定する。なお、上記心室性期外収縮には、1分間に5、6回以上期外収縮が発生する多発性心室性期外収縮、期外収縮の R 波が直前の正常な波形の T 波の上に重なるようにして発生する $R-on-T$ 型期外収縮、心室性期外収縮が3、4個以上連なって発生するショートラン型期外収縮などがあり、これらの心室性期外収縮を、検出された心電誘導波形と予め記憶された正常時の形状との比較により検出する。また、上記のような $S-T$ レベルの上昇・下降および心室性期外収縮の検出以外にも、心電誘導波形に基づいて心拍周期 T_r を決定し、その心拍周期 T_r が異常に短い頻脈、心拍周期 T_r が異常に長い徐脈等の不整脈も判定する。

【0034】異常判定手段72は、上記不整脈判定手段70により不整脈が発生したと判定され、且つ、その不

整脈が発生したと判定された時点において、前記変化値算出手段68により算出された変化値 ΔEBP が予め設定された判定基準値 $TH(\Delta)$ を越えたことに基づいて、患者の循環状態が異常であると判定する。そして、循環状態が異常であると判定した場合には、信頼性のある血压値 BP を測定するために、前記血压測定手段60を実行させる。上記不整脈が発生したと判定された時点において算出された変化値 ΔEBP とは、不整脈が発生したと判定された時にすでに算出されている変化値 ΔEBP のうち最も新しいもの、または、不整脈が発生したと判定された直後に算出された変化値 ΔEBP をいう。上記判定基準値 $TH(\Delta)$ は予め実験に基づいて決定された値であり、変化値 ΔEBP が変化率である場合にはたとえば20~30%、変化値 ΔEBP が変化量である場合にはたとえば20~30mmHgとされる。なお、推定血压値 EBP が低下している場合には、上記変化値 ΔEBP は負の値となるが、この異常判定手段72においては絶対値により判定する。すなわち、不整脈が発生した時点において、血压が上昇傾向にある場合にも血压が低下傾向にある場合にも循環状態の異常が判定される場合がある。

【0035】また、前記切り換えスイッチ56からの低血压患者信号が供給された場合には、異常判定手段72は、不整脈判定手段70により不整脈が発生したと判定され、且つ、変化値算出手段68により算出された変化値 ΔEBP 、およびその不整脈が発生した時点において前記推定血压値算出手段64により算出された推定血压値 EBP の少なくとも一方が予めそれぞれについて設定された判定基準値 $TH(\Delta)$ 、 $TH(BP)$ を越えたことに基づいて、患者の循環状態が異常であると判定する。推定血压値 EBP についての判定基準値 $TH(BP)$ は、推定血压値 EBP が最高血压値を表している場合には、たとえば80~90mmHgに設定される。低血压患者の場合には、正常な状態でも血压値 BP が低いので、血压の変化がそれほど大きくないために、推定血压値 EBP の変化値 ΔEBP が上記判定基準値 $TH(\Delta)$ を越えない場合であっても、緊急の処置を必要とするほどに血压が低下している場合があるので、絶対値が低い場合にも循環状態が異常であると判定するのである。

【0036】異常表示手段74は、上記異常判定手段72により患者の循環状態が異常であると判定された場合には、その旨の表示を表示器36に表示する。

【0037】図4は、上記電子制御装置28の制御作動の要部をさらに具体的に説明するフローチャートであって、推定血压値 EBP の算出に用いる対応関係式を決定するために実行される対応関係決定ルーチンである。まず、図のステップSA1(以下、ステップを省略する。)においてタイマ t やレジスタをクリアする初期処理が実行され、続くSA2では、切換弁16が圧力供給状態に切り換えられ且つ空気ポンプ18が駆動されるこ

とにより、血圧測定のためにカフ10の急速昇圧が開始される。

【0038】次いで、脈波伝播速度情報算出手段64に対応するSA3では、図3にも示す脈波伝播時間 DT_{tr} 、すなわち心電誘導波形のR波が検出された時点から光電脈波センサ40により光電脈波の立ち上がり点が検出された時点までの時間差が算出される。

【0039】続くSA4では、カフ圧 P_c が180mmHg程度に予め設定された目標圧 $P_{c_{max}}$ 以上となったか否かが判断される。このSA4の判断が否定された場合は、SA4の判断が繰り返し実行されることにより、カフ圧 P_c の上昇が継続される。しかし、カフ圧 P_c の上昇により上記SA4の判断が肯定されると、続くSA5では、空気ポンプ18が停止され、SA6では、圧力制御弁16が徐速排圧状態に切り換えられて、カフ10内の圧力が予め定められた3mmHg/sec程度の緩やかな速度で下降させられ始める。

【0040】続くSA7では、その徐速降圧過程で逐次得られるカフ脈波信号 SM_1 が表す脈波の振幅の変化に基づいて、良く知られたオシロメトリック方式の血圧値決定アルゴリズムに従って最高血圧値 BP_{sys} 、平均血圧値 BP_{mean} 、および最低血圧値 BP_{dia} が順次決定される。そして、最低血圧値 BP_{dia} が決定されると、続くSA8では、圧力制御弁16が急速排圧状態に切り換えられてカフ10内が急速に排圧される。従って、上記SA2、SA4~SA8が血圧測定手段60に対応する。

【0041】続いて前記対応関係決定手段66に対応するSA9が実行される。すなわち、今回のルーチンにおいて上記SA3で算出された脈波伝播時間 DT_{tr} および上記SA7で決定された最高血圧値 BP_{sys} を一組とし、前回のルーチンにおいて決定された脈波伝播時間 DT_{tr} および最高血圧値 BP_{sys} を他の一組として、前記式2の定数 α および β が決定される。なお、循環状態監視装置8の起動時において本対応関係決定ルーチンが最初に実行される場合には、定数 α および β のいずれか一方には統計的に求められた一般値が用いられる。

【0042】図5も、前記電子制御装置28の制御作動の要部をさらに具体的に説明するフローチャートであって、図4の対応関係決定ルーチンに続いて実行される循環状態監視ルーチンである。なお、図5に示す循環状態監視ルーチンは、切り換えスイッチ56からの低血圧信号が供給された場合に実行される低血圧患者用の循環状態監視ルーチンである。

【0043】まず、SB1では、光電脈波センサ40および心電信号検出装置50から連続的に供給される光電脈波信号 SM_2 および心電誘導信号SEが一拍分入力されたか否かが、たとえば、光電脈波信号 SM_2 が表す光電脈波のピークが検出されたか否かに基づいて判断される。このSB1の判断が否定された場合には、SB1の

判断が繰り返され、その間に、光電脈波信号 SM_2 および心電誘導信号SEがさらに供給される。

【0044】一方、上記SB1の判断が肯定された場合には、続く脈波伝播速度情報算出手段62に対応するSB2において、上記SB1で入力された最新の一拍分の光電脈波および心電誘導波形に基づいて、その心電誘導波形のR波が検出された時点から上記光電脈波の立ち上がり点が検出された時点までの時間差すなわち脈波伝播時間 DT_{tr} が算出される。

【0045】続く推定血圧値算出手段64に対応するSB3では、上記SB2において決定された脈波伝播時間 DT_{tr} が、図4のSA9において定数 α 、 β が決定された式2に代入されることにより推定血圧値EBPが算出され、その算出された推定血圧値EBPがRAM34の所定の記憶領域に記憶される。

【0046】続く不整脈判定手段70に対応するSB4では、前記SB1において入力された心電誘導信号SEを含む所定区間の心電誘導信号SEが表す心電誘導波形が、予め記憶された正常心電誘導波形と比較されることにより、不整脈が発生したか否かが判断される。

【0047】上記SB4の判断が肯定された場合には、続く変化値算出手段68に対応するSB5において、前記SB3で算出された推定血圧値EBPの変化値 ΔEBP として、そのSB3で算出された推定血圧値EBPの、前記対応関係決定ルーチンが実行された直後において前記SB3で算出された推定血圧値EBPに対する変化率(%)が算出される。

【0048】続いて異常判定手段74に対応するSB6乃至SB7が実行される。まず、SB6では、前記SB3で算出された推定血圧値EBPが判定基準値TH(BP)として予め設定された80mmHgよりも小さいか否かが判断される。この判断が否定された場合には、続くSB7において、上記SB5で算出された変化値 ΔEBP が判定基準値TH(Δ)として予め設定された20%よりも大きいかが判断される。前記SB6の判断が肯定された場合、または上記SB7の判断が肯定された場合には、続く異常表示手段74に対応するSB8において、表示器36に循環状態が異常である旨の表示がされ、その後、より信頼性のある血圧値を得るために図4の対応関係決定ルーチンが実行され、カフ10による血圧測定が実行される。

【0049】一方、前記SB4の判断が否定された場合、または、前記SB7の判断が否定された場合には、SB9において、図4の対応関係決定ルーチンが実行されてからの経過時間が予め設定された15乃至20分程度の設定周期すなわちキャリブレーション周期を経過したか否かが判断される。このSB9の判断が否定された場合は、前記SB1以下の循環状態監視ルーチンが繰り返し実行され、SB9の判断が肯定された場合には、前記式2の対応関係を再決定するために図4の対応関係決

定ルーチンが再び実行される。

【0050】上述した実施の形態によれば、変化値算出手段68(SB5)により、推定血圧値算出手段64(SB3)によって算出された推定血圧値EBPの変化値 ΔEBP が算出され、異常判定手段72(SB6乃至SB7)により、不整脈判定手段70(SB4)によって不整脈が発生したと判定され、且つ、変化値算出手段68(SB5)により算出された変化値 ΔEBP が予め設定された判定基準値TH(Δ)を越えた場合に循環状態が異常であると判定されるので、正確に循環状態が判定される。加えて、脈波伝播時間DT_{tr}は、光電脈波センサ40および心電信検出装置50により、生体を止血することなく検出された光電脈波および心電誘導波形に基づいて決定され、推定血圧値EBPは、その脈波伝播時間DT_{tr}に基づいて決定されるので、不整脈が発生したと判定される毎に生体の一部を止血して患者に苦痛を与えるという不都合が解消される。

【0051】また、上述の実施の形態によれば、切り換えスイッチ56から予め低血圧患者信号を入力しておく、不整脈が発生したと判定された場合には、異常判定手段72(SB6乃至SB7)により、変化値算出手段68(SB5)により算出された変化値 ΔEBP および推定血圧値算出手段64(SB3)により算出された推定血圧値EBPの少なくとも一方が予めそれぞれについて設定された判定基準値TH(Δ)、TH(BP)を越えた場合には、循環状態が異常であると判定されるので、低血圧患者であっても、確実に循環状態の異常が判定される。

【0052】また、上述の実施の形態によれば、心拍同期波検出装置として心電信検出装置50が用いられている。この心電信検出装置50により検出される心電誘導信号SEは所謂心電図であり、不整脈判定手段70(SB4)では、その心電図に基づいて不整脈が判定されるので、様々な種類の不整脈を判定することができる。

【0053】次に、本発明の他の実施の形態を説明する。なお、以下の説明において前述の実施形態と共通する部分は同一の符号を付して詳細な説明を省略する。

【0054】図6は、本発明が適用された循環状態監視装置75における電子制御装置28の制御機能の要部を説明する機能ブロック線図である。なお、この循環状態監視装置75が前述の循環状態監視装置8と異なる点は、光電脈波センサ40、A/D変換器48を備えていないこと、および電子制御装置28の制御機能のみである。

【0055】図6において、変化値算出手段76は、血圧測定手段60により決定された血圧値BPの変化値 ΔBP を算出する。ここで、変化値 ΔBP とは、血圧値BPの変化率(%)または変化量(mmHg)であり、たとえば前回血圧測定手段60により測定された最高血圧値BP

515 に対する今回血圧測定手段60により測定された最高血圧値BP_{sys}の変化率または変化量である。

【0056】異常判定手段78は、前記不整脈判定手段70により不整脈が発生したと判定された場合に、血圧測定手段60および変化値算出手段76を実行し、その変化値算出手段76により算出された変化値 ΔBP が予め設定された判定基準値TH(Δ)を越えたことに基
10 づいて、患者の循環状態が異常であると判定する。なお、この変化値 ΔBP が判定基準値TH(Δ)を越えたか否かの判断も前述の異常判定手段72と同様に、絶対値により行なう。また、前記切り換えスイッチ56からの低血圧信号が供給された場合には、異常判定手段78は、血圧測定手段60により決定された血圧値BP、およびその血圧値BPに基づいて変化値算出手段76により算出された変化値 ΔBP の少なくとも一方が予めそれぞれについて設定された判定基準値TH(BP)、TH(Δ)を越えたことに基
20 づいて、患者の循環状態が異常であると判定する。血圧値BPについての判定基準値TH(BP)は、判定に用いられる血圧値BPが最高血圧値BP_{sys}であるか、平均血圧値BP_{mean}であるか、最低血圧値BP_{dia}であるかによって異なるが、最高血圧値BP_{sys}が判定に用いられる場合には、判定基準値TH(BP)はたとえば80~90mmHgに設定される。

【0057】上述の実施形態によれば、異常判定手段78により、不整脈判定手段70によって不整脈が発生したと判定された場合には、血圧測定手段60により血圧値BPが測定され、変化値算出手段76によりその血圧値BPの変化値 ΔBP が算出され、さらに、その変化値 ΔBP が予め設定された判定基準値TH(Δ)を越えたことに基
30 づいて循環状態が異常であると判定される。すなわち、不整脈と血圧の変化とに基づいて生体の循環状態の異常が判定されるので、正確に循環状態が判定される。

【0058】また、上述の実施形態によれば、切り換えスイッチ56から予め低血圧患者信号を入力しておく、不整脈が発生したと判定された場合には、異常判定手段78により、変化値算出手段76によって算出された変化値 ΔBP および血圧測定手段60によって測定された血圧値BPの少なくとも一方が予めそれぞれについて設定された判定基準値TH(Δ)、TH(BP)を越えたことに基
40 づいて循環状態が異常であると判定されるので、より確実に循環状態の異常が判定される。

【0059】次に、本発明のさらに他の実施形態の説明する。図7は、本発明が適用された循環状態監視装置80における電子制御装置28の制御機能の要部を説明する機能ブロック線図である。なお、この循環状態監視装置80は、光電脈波センサ40、A/D変換器48、心電信検出装置50、電極52、A/D変換器54、切り換えスイッチ56が設けられていないこと、および電子制御装置28の制御機能が前述の循環状態監視装置8

と異なる以外は前述の循環状態監視装置 8 と同一の構成を有する。

【0060】図 7 において、脈拍周期決定手段 82 は、空気ポンプ 18 および切換弁 16 を制御して、カフ 10 の圧迫圧力を最低血圧値よりも十分に低い値に予め設定された圧力（たとえば 20～30 mmHg）に制御し、その状態で図示しない上腕動脈からカフ 10 に伝達される上腕動脈波を、圧力センサ 14 および脈波弁別回路 24 により検出し、その検出された上腕動脈波の所定部位（たとえば立ち上がり点或いはピーク）に基づいて、脈拍周期 T_P を決定する。この上腕動脈波は心拍同期波であることから、カフ 10、圧力センサ 14、および脈波弁別回路 24 は、心拍同期波検出装置として機能する。

【0061】不整脈判定手段 84 は、脈拍周期決定手段 82 により決定された脈拍周期 T_P に基づいて不整脈を判定する。すなわち、この不整脈判定手段 84 は、不整脈のうち、脈波周期 T_P に基づいて判定できる不整脈のみを判定する。脈拍周期 T_P に基づいて判定できる不整脈としては、徐脈、頻脈、頻拍症、期外収縮、心房細動などがある。

【0062】第 1 異常判定手段 86 は、血圧測定手段 60 により測定された血圧値 B_P が予め設定された第 1 基準血圧値 B_{P1} 以下であることに基づいて、患者の循環状態が異常であると判定する。上記第 1 基準血圧値 B_{P1} は、判定される血圧値 B_P が最高血圧値 $B_{P_{SYS}}$ であるか、平均血圧値 $B_{P_{MEAN}}$ であるか、最低血圧値 $B_{P_{DIA}}$ によって異なるが、判定される血圧値 B_P が最高血圧値 $B_{P_{SYS}}$ である場合には、上記第 1 基準血圧値 B_{P1} は、たとえば 70 mmHg に設定される。

【0063】第 2 異常判定手段 88 は、前記不整脈判定手段 84 により不整脈が発生したと判定された場合に、血圧測定手段 60 を実行し、その血圧測定手段 60 により決定された血圧値 B_P が予め設定された第 2 基準血圧値 B_{P2} 以下であることに基づいて、患者の循環状態が異常であると判定する。上記第 2 基準血圧値 B_{P2} は、前記第 1 基準血圧値 B_{P1} よりも 5～30 mmHg 程度大きい値に設定され、また、前記第 1 基準血圧値 B_{P1} と同様に、判定される血圧値 B_P が最高血圧値 $B_{P_{SYS}}$ であるか、平均血圧値 $B_{P_{MEAN}}$ であるか、最低血圧値 $B_{P_{DIA}}$ によって異なる。

【0064】異常表示手段 90 は、上記第 1 異常判定手段 86 または第 2 異常判定手段 88 により患者の循環状態が異常であると判定された場合には、その旨の表示を表示器 36 に表示する。

【0065】図 8 は、循環状態監視装置 80 における上記電子制御装置 28 の制御作動の要部をさらに具体的に説明するフローチャートである。まず、SC1 では、タイマ t やレジスタをクリアする初期処理が実行される。

【0066】続く SC2 では、前回カフ 10 による血圧測定が実行されてからの経過時間が予め設定された 15

乃至 20 分程度の血圧測定起動周期を経過したか否かがタイマ t に基づいて判断される。この SC2 の判断が肯定された場合には、続く血圧測定手段 60 に対応する SC3 において血圧測定ルーチンが実行されることにより、カフ 10 を用いて血圧値 B_P が測定される。この血圧測定ルーチンは、前述の図 4 の SA2、SA4～SA8 と同様の処理である。

【0067】続く第 1 異常判定手段 86 に対応する SC4 では、上記 SC3 で測定された最高血圧値 $B_{P_{SYS}}$ が、第 1 基準血圧値 B_{P1} として設定された 70 mmHg 以下であるか否かが判断される。この判断が否定された場合には、前述の SC1 以下が繰り返し実行される。一方、肯定された場合には後述する SC13 が実行される。

【0068】前記 SC2 の判断が否定された場合、すなわち、未だ血圧測定起動周期が経過していない場合には、続く SC5 において、タイマ t の内容に「1」が加算された後、脈拍周期決定手段 82 に対応する SC6 乃至 SC9 が実行される。

【0069】まず、SC6 では、空気ポンプ 18 および圧力制御弁 16 が制御されることにより、カフ 10 の圧迫圧力が 20～30 mmHg の低圧とされ、その圧力が維持される。続く SC7 では、その状態で圧力センサ 14 により検出され、さらに脈波弁別回路 24 により検出されたカフ脈波信号 SM_i すなわち上腕動脈波が読み込まれる。

【0070】続く SC8 では、上記 SC7 においてカフ脈波信号 SM_i が一拍分読み込まれたか否かが判断される。この SC8 の判断が否定されるうちは、上記 SC7 以下が繰り返し実行されることにより、カフ脈波信号 SM_i の読み込みが継続されるが、肯定された場合には、続く脈拍周期決定手段 82 に対応する SC9 において、上記 SC7 乃至 SC8 の繰り返しにより読み込まれたカフ脈波信号 SM_i が表す上腕動脈波の所定部位（たとえばピーク）が決定され、その所定部位の間隔から脈拍周期 T_P が決定される。

【0071】続く不整脈判定手段 84 に対応する SC10 では、上記 SC9 で決定された脈拍周期 T_P の変化に基づいて不整脈が発生したか否かが判断される。この SC10 の判断が否定された場合には、前記 SC2 以降が繰り返し実行される。しかし、上記 SC10 の判断が肯定された場合には、続く血圧測定手段 60 に対応する SC11 において前述の SC3 と同様の血圧測定ルーチンが実行される。

【0072】続く第 2 異常判定手段 88 に対応する SC12 では、上記 SC11 で測定された最高血圧値 $B_{P_{SYS}}$ が、第 2 基準血圧値 B_{P2} として予め設定された 80 mmHg 以下であるか否かが判断される。この SC12 の判断が否定された場合には、前記 SC2 以降が繰り返し実行される。

【0073】一方、上記SC12の判断が肯定された場合、または、前記SC4の判断が肯定された場合には、続く異常表示手段90に対応するSC13において、表示器36に循環状態が異常である旨の表示がされた後、本ルーチンは終了させられる。

【0074】上述の実施形態によれば、第1異常判定手段86(SC4)により、血圧測定手段60(SC3)によって測定された最高血圧値 $B_{P_{SYS}}$ が予め設定された第1基準血圧値 B_{P_1} 以下である場合には生体の循環状態の異常が判定される。また、第1異常判定手段86(SC4)により循環状態の異常が判定されない場合にも、第2異常判定手段88(SC12)により、不整脈判定手段84(SC10)によって不整脈が発生したと判定された場合には、血圧測定手段60(SC11)により最高血圧値 $B_{P_{SYS}}$ が測定され、その最高血圧値 $B_{P_{SYS}}$ が第1基準血圧値 B_{P_1} よりも大きい値に予め設定された第2基準血圧値 B_{P_2} 以下である場合には生体の循環状態の異常が判定されるので、正確に循環状態の異常が判定される。

【0075】また、本実施形態によれば、血圧測定のためのカフ10を用いて上腕動脈波(心拍同期波)を検出するので、循環状態監視装置80は構成が簡単になり、且つ、安価になる。

【0076】次に、本発明のさらに他の実施形態の説明する。図9は、本発明が適用された循環状態監視装置92における電子制御装置28の制御機能の要部を説明する機能ブロック線図である。なお、この循環状態監視装置92は、切り換えスイッチ56が設けられていないこと、および電子制御装置28の制御機能が前述の循環状態監視装置8と異なる以外は前述の循環状態監視装置8と同一の構成を有する。

【0077】図9において、第2異常判定手段94は、前記不整脈判定手段70により不整脈が発生したと判定され、且つ、その不整脈が発生したと判定された時点において、前記推定血圧値算出手段64により算出された推定血圧値 E_{BP} が予め設定された第2基準血圧値 B_{P_2} 以下であることに基づいて、患者の循環状態が異常であると判定する。この第2基準血圧値 B_{P_2} は前述の実施形態における値と同じである。すなわち、第2基準血圧値 B_{P_2} は、前記第1基準血圧値 B_{P_1} よりも5~30mmHg程度大きい値に設定され、また、前記第1基準血圧値 B_{P_1} と同様に、判定される血圧値 B_{P_1} が最高血圧値 $B_{P_{SYS}}$ であるか、平均血圧値 $B_{P_{MEAN}}$ であるか、最低血圧値 $B_{P_{DIA}}$ によって異なる。

【0078】上述の実施形態によれば、第1異常判定手段86により、血圧測定手段60により測定された血圧値 B_{P_1} が予め設定された第1基準血圧値 B_{P_1} 以下であることに基づいて生体の循環状態の異常が判定される。また、第1異常判定手段86により循環状態の異常が判定されない場合にも、第2異常判定手段94により、不

整脈判定手段70によって不整脈が発生したと判定され、且つ、推定血圧値算出手段64により算出された推定血圧値 E_{BP} が前記第1基準血圧値 B_{P_1} よりも大きい値に予め設定された第2基準血圧値 B_{P_2} 以下であることに基づいて循環状態が異常であると判定されるので、正確に循環状態が判定される。加えて、脈波伝播速度情報は、光電脈波センサ40および心電信号検出装置50により、生体を止血することなく検出された光電脈波および心電誘導波形に基づいて決定され、推定血圧値 E_{BP} は、その脈波伝播速度情報に基づいて決定されるので、不整脈が発生したと判定される毎に生体の一部を止血して患者に苦痛を与えるという不都合が解消される。

【0079】以上、本発明の一実施形態を図面に基づいて詳細に説明したが、本発明はその他の態様においても適用される。

【0080】たとえば、前述の実施形態では、心電波形検出装置50が心拍同期波検出装置として用いられ、または、カフ10、圧力センサ14、および脈波弁別回路24が心拍同期波検出装置として用いられていたが、生体内を伝播する脈波は心拍同期波であることから、その脈波を検出する脈波検出装置が心拍同期波検出装置として用いられてもよい。すなわち、前述の光電脈波センサ40、オキシメータ用の光電脈波検出プローブ、生体に装着された電極を介してインピーダンス変化を検出するインピーダンス脈波検出装置、頸動脈や橈骨動脈に押圧されてその内圧を検出する圧脈波検出装置等が心拍同期波検出装置として用いられてもよい。また、心音も心拍同期波であることから、心音を検出する心音検出装置が心拍同期波検出装置として用いられてもよい。

【0081】また、前述の実施形態においては、血圧関連情報として脈波伝播速度情報が算出されていたが、前記光電脈波センサ40等により測定される脈波の面積 S は、血圧に関連して変動するので、脈波の面積 S や、その面積 S をその脈波の1周期 W および振幅 L に基づいて正規化した正規化脈波面積 V_R が血圧関連情報として算出されてもよい。また、心拍周期 T 、および心拍数 HR も血圧に関連するので、それら心拍周期 T 、および心拍数 HR が血圧関連情報として用いられてもよい。

【0082】また、前述の実施形態では、循環状態の異常が判定された場合には、異常表示手段74、90により、表示器36に循環状態が異常である旨の表示がされていたが、その表示に代えて、または、その表示とともに、警報音を発生させてもよい。

【0083】また、前述の第1の実施形態では、異常判定手段72は、循環状態の異常を判定した場合には、血圧測定手段60による血圧測定を実行させていたが、この血圧測定手段60による血圧測定は実行されなくてもよい。

【0084】なお、本発明はその主旨を逸脱しない範囲

においてその他種々の変更が加えられ得るものである。

【図面の簡単な説明】

【図1】本発明の一実施形態である循環状態監視装置の回路構成を説明するブロック線図である。

【図2】図1の循環状態監視装置における電子制御装置の制御機能の要部を説明する機能ブロック線図である。

【図3】図1の循環状態監視装置における電子制御装置の制御作動により求められる脈波伝播時間 DT_{RP} を例示する図である。

【図4】図1の循環状態監視装置における電子制御装置の制御作動の要部をさらに具体的に説明するフローチャートであって、推定血圧値 EBP の算出に用いる対応関係式を決定するために実行される対応関係決定ルーチンである。

【図5】図1の循環状態監視装置における電子制御装置の制御作動の要部をさらに具体的に説明するフローチャートであって、図4の対応関係決定ルーチンに続いて実行される循環状態監視ルーチンである。

【図6】本発明の他の実施形態であって、図1とは別の循環状態監視装置における電子制御装置の制御機能の要部を説明する機能ブロック線図である。

【図7】本発明の他の実施形態であって、図1および図6とは別の循環状態監視装置における電子制御装置の制御機能の要部を説明する機能ブロック線図である。

【図8】図7の循環状態監視装置における電子制御装置の制御作動の要部をさらに具体的に説明するフローチャートである。

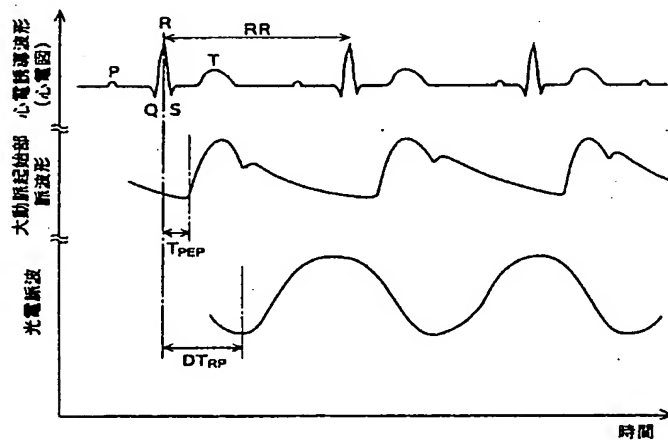
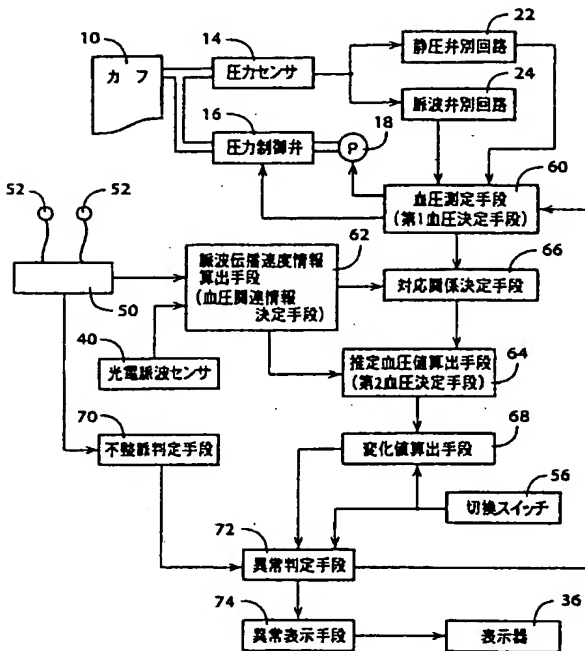
【図9】本発明の他の実施形態であって、図1、図6、および図7とは別の循環状態監視装置における電子制御装置の制御機能の要部を説明する機能ブロック線図である。

【符号の説明】

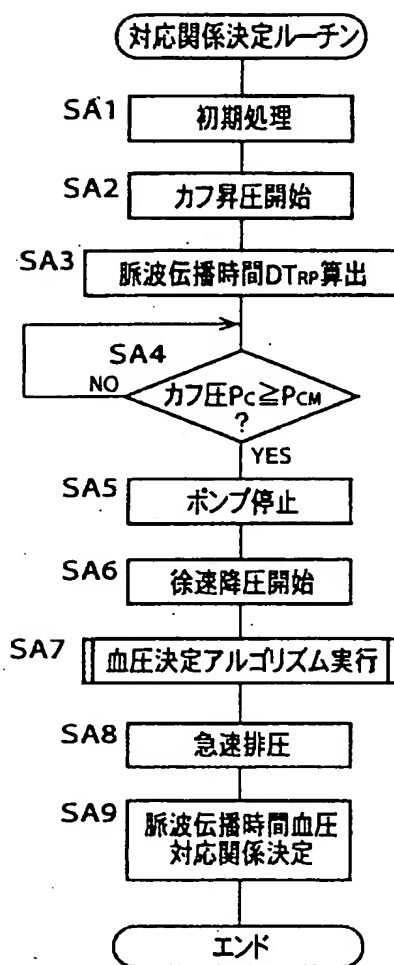
- 8：循環状態監視装置
- 10：カフ
- 40：光電脈波センサ（脈波検出装置）
- 50：心電信号検出装置（心拍同期波検出装置）
- 60：血圧測定手段（第1血圧決定手段）
- 62：脈波伝播速度情報算出手段（血圧関連情報決定手段）
- 64：推定血圧値算出手段（第2血圧決定手段）
- 66：対応関係決定手段
- 68：変化値算出手段
- 70：不整脈判定手段
- 72：異常判定手段
- 75：循環状態監視装置
- 76：変化値算出手段
- 78：異常判定手段
- 80：循環状態監視装置
- 84：不整脈判定手段
- 86：第1異常判定手段
- 88：第2異常判定手段
- 92：循環状態監視装置
- 94：第2異常判定手段

【図2】

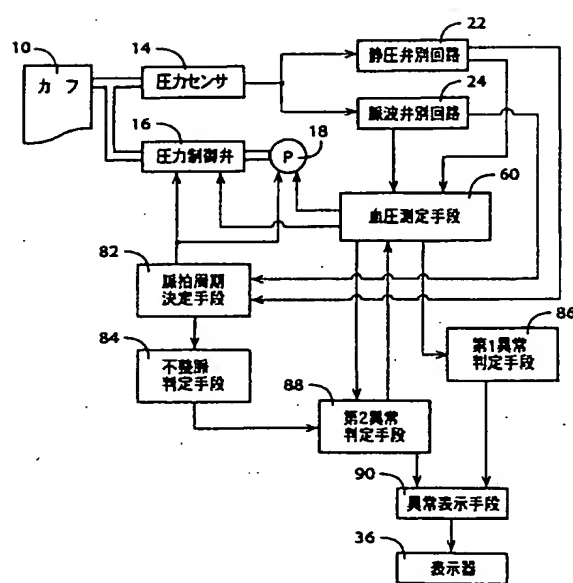
【図3】



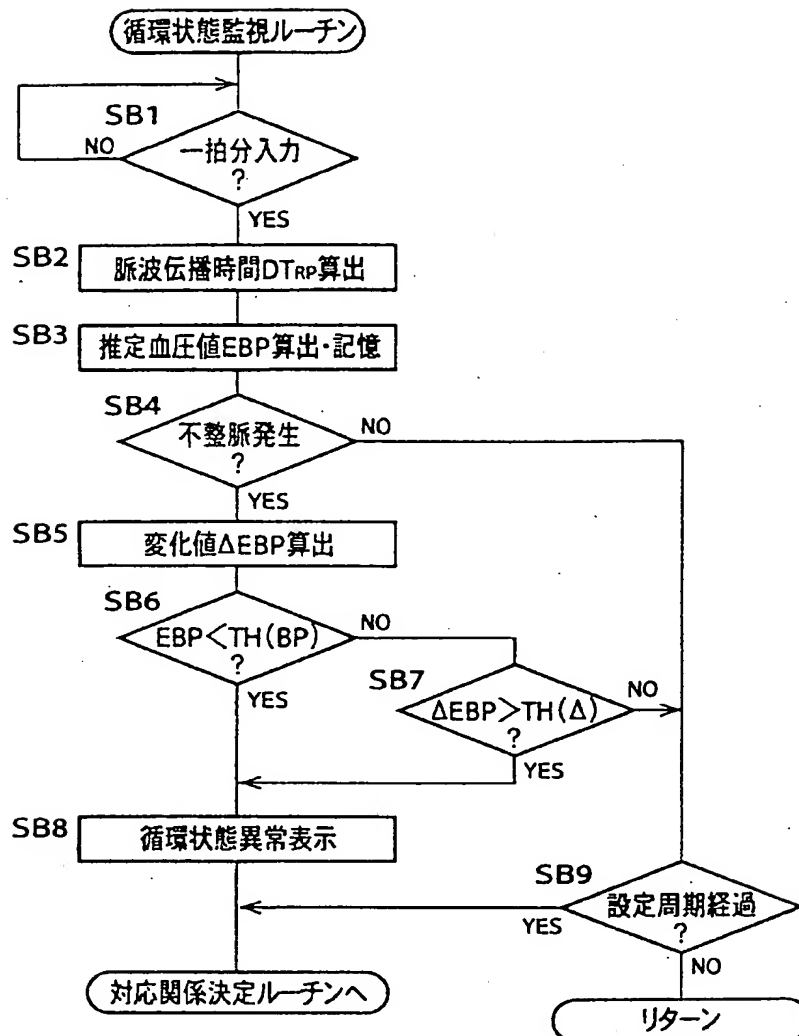
【图 4】



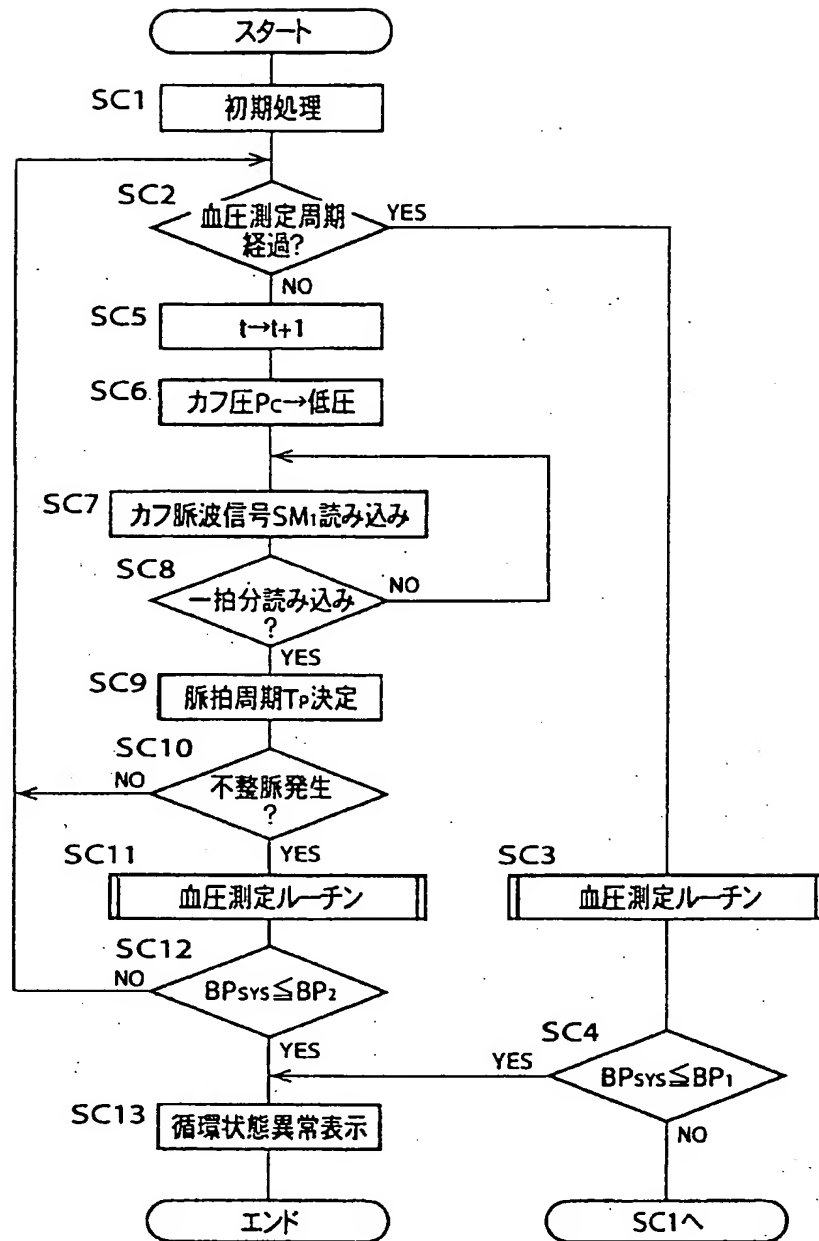
【图 7.】



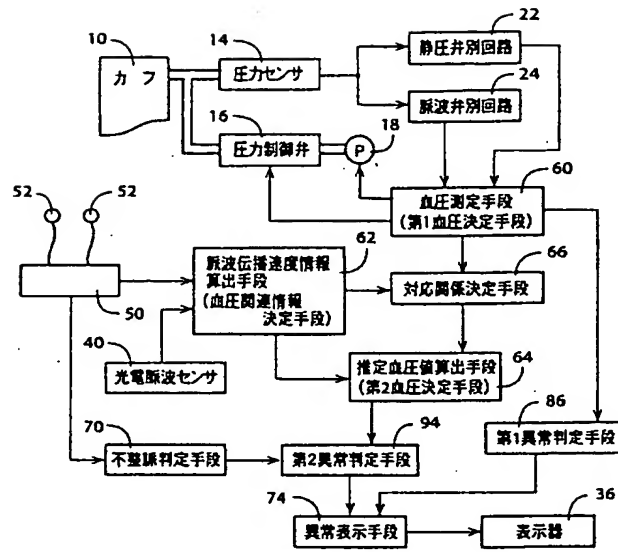
【図 5】



【図 8】



【図9】



PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-346769

(43)Date of publication of application : 18.12.2001

(51)Int.Cl. A61B 5/022
A61B 5/0205
A61B 5/0245
A61B 5/0402

(21)Application number : 2000-173700 (71)Applicant : NIPPON COLIN CO LTD

(22)Date of filing : 09.06.2000 (72)Inventor : OKA SUSUMU

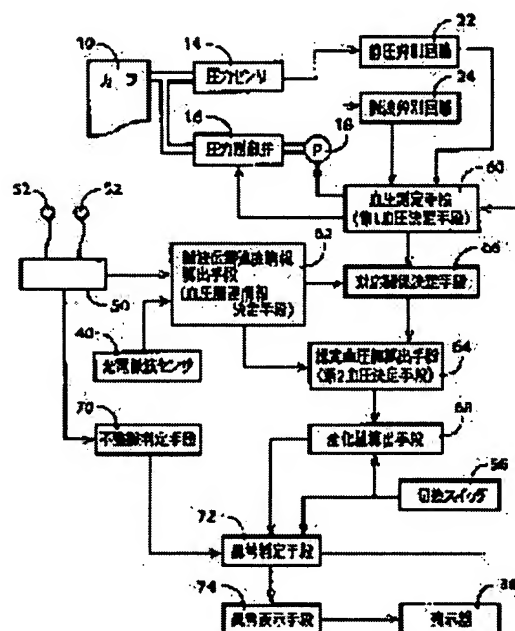
(54) CIRCULATION STATE MONITORING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a circulation state monitoring device capable of correctly determining a circulation state of a patient.

SOLUTION: A variation value Δ EBP of an estimated blood pressure value EBP determined by an estimated blood pressure value determining means 64 is determined by a variation value determining means 68, and in an abnormality determining means 72, it is determined that the circulation state is abnormal when generation of arrhythmias is determined by an arrhythmia determining means 70, and as the change value Δ EBP determined by the change value determining means 68 exceeds a determination reference value TH (Δ) which is preliminarily set.

Abnormality in the circulation state is thus determined based on the arrhythmias and change of blood pressure, thereby the circulation state can be correctly determined.



LEGAL STATUS

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rejection]

[Kind of final disposal of application other than
the examiner's decision of rejection or
application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

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CLAIMS

[Claim(s)]

[Claim 1] The heartbeat synchronization-voltage detection equipment with which a living body is equipped and which detects this living body's heartbeat synchronization voltage, It has an arrhythmic judging means to judge arrhythmia based on the heartbeat synchronization voltage detected by this heartbeat synchronization-voltage detection equipment. It is circulation condition-monitoring equipment which supervises the state where blood circulates in the living body. A 1st blood-pressure determination means to determine this living body's 1st blood-pressure value based on the pulse wave generated in process in which carry out the hemostasis of this part by the cuff wound around the aforementioned living body's predetermined part, and **** pressure lowering of the compression pressure force of this cuff is carried out continuously, A blood-pressure related information determination means to determine serially the blood-pressure related information changed in relation to the aforementioned living body's blood pressure based on the pulse wave detected without carrying out the hemostasis of this part with the pulse wave detection equipment with which the aforementioned living body's predetermined part is equipped, A correspondence relation determination means to determine the correspondence relation between the 1st blood-pressure values determined by the blood-pressure related information and the aforementioned 1st blood-pressure determination means which were serially determined by this blood-pressure related information determination means, A 2nd blood-pressure determination means to determine serially the aforementioned living body's 2nd blood-pressure value based on the blood-pressure related information serially determined by the aforementioned blood-pressure related information determination means using the correspondence relation determined by this correspondence relation determination means, A change value calculation means to compute serially the 2nd blood-pressure value-change value determined by this 2nd blood-pressure determination means, The change value which was judged as arrhythmia having occurred by the aforementioned arrhythmic judging means, and was computed by the aforementioned change value calculation means is based on having exceeded the criterion value set up beforehand. Circulation condition-monitoring equipment characterized by the aforementioned living body's circulation condition including an unusual judging means to judge with it being unusual.

[Claim 2] The heartbeat synchronization-voltage detection equipment with which a living body is equipped and which detects this living body's heartbeat synchronization voltage, It has an arrhythmic judging means to judge arrhythmia based on the heartbeat synchronization voltage detected by this heartbeat synchronization-voltage detection equipment. A blood-pressure-measurement means to be circulation condition-monitoring equipment which supervises the state where blood circulates in the living body [aforementioned], and to measure this living body's blood-pressure value based on the pulse wave generated in the process of the compression pressure force of this cuff using the cuff wound around the aforementioned living body's predetermined part, A change value calculation means to compute serially the blood-pressure value-change value determined by this blood-pressure-measurement means, When judged with arrhythmia having occurred by the aforementioned arrhythmic judging means, the aforementioned blood-pressure-measurement means and the aforementioned change value

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calculation means are performed. Circulation condition-monitoring equipment characterized by the aforementioned living body's circulation condition including an unusual judging means to judge with it being unusual, based on the change value computed by this change value calculation means having exceeded the criterion value set up beforehand.

[Claim 3] The heartbeat synchronization-voltage detection equipment with which a living body is equipped and which detects this living body's heartbeat synchronization voltage, An arrhythmic judging means to judge arrhythmia based on the heartbeat synchronization voltage detected by this heartbeat synchronization-voltage detection equipment, A blood-pressure-measurement means to be circulation condition-monitoring equipment which supervises the state where blood circulates in the living body, and to measure this living body's blood-pressure value based on the pulse wave generated in the process of the compression pressure force of this cuff using the cuff wound around the aforementioned living body's predetermined part, A 1st abnormality judging means to judge with the aforementioned living body's circulation condition being unusual based on being below the 1st criteria blood-pressure value to which the blood-pressure value determined by this blood-pressure-measurement means was set beforehand, When judged with arrhythmia having occurred by the aforementioned arrhythmic judging means, the aforementioned blood-pressure-measurement means is performed. Circulation condition-monitoring equipment characterized by the aforementioned living body's circulation condition including a 2nd abnormality judging means to judge with it being unusual, based on the blood-pressure value determined by this blood-pressure-measurement means being below the 2nd criteria blood-pressure value beforehand set as the larger value than the aforementioned 1st criteria blood-pressure value.

[Claim 4] The heartbeat synchronization-voltage detection equipment with which the aforementioned living body is equipped and which detects this living body's heartbeat synchronization voltage, It has an arrhythmic judging means to judge arrhythmia based on the heartbeat synchronization voltage detected by this heartbeat synchronization-voltage detection equipment. It is circulation condition-monitoring equipment which supervises the state where blood circulates in the living body. A 1st blood-pressure determination means to determine this living body's 1st blood-pressure value based on the pulse wave generated in process in which carry out the hemostasis of this part by the cuff wound around the aforementioned living body's predetermined part, and **** pressure lowering of the compression pressure force of this cuff is carried out continuously, Pulse wave machine ***** detected without carrying out the hemostasis of this part with the pulse wave detection equipment with which the aforementioned living body's predetermined part is equipped, and a blood-pressure related information determination means to determine serially the blood-pressure related information changed in relation to the aforementioned living body's blood pressure, A correspondence relation determination means to determine the correspondence relation between the 1st blood-pressure values determined by the blood-pressure related information and the aforementioned 1st blood-pressure determination means which were serially determined by this blood-pressure related information determination means, A 2nd blood-pressure determination means to determine serially the aforementioned living body's 2nd blood-pressure value based on the blood-pressure related information serially determined by the aforementioned blood-pressure related information determination means using the correspondence relation determined by this correspondence relation determination means, A 1st abnormality judging means to judge with the aforementioned living body's circulation condition being unusual based on being below the 1st criteria blood-pressure value to which the 2nd blood-pressure value determined by this 2nd blood-pressure determination means was set beforehand, The 2nd blood-pressure value which was judged as arrhythmia having occurred by the aforementioned arrhythmic judging means, and was determined by the aforementioned 2nd blood-pressure determination means is based on it being below the 2nd criteria blood-pressure value beforehand set as the larger value than the aforementioned 1st criteria blood-pressure value. Circulation condition-monitoring equipment characterized by the aforementioned living body's circulation condition including a 2nd abnormality judging means to judge with it being unusual.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the circulation condition-monitoring equipment which supervises the state where blood circulates in the living body.

[0002]

[Description of the Prior Art] When a patient is equipped with heartbeat synchronization-voltage detection equipment, a living body's arrhythmic generating is judged based on the heartbeat synchronization voltage detected by the heartbeat synchronization-voltage detection equipment and it judges with arrhythmia having occurred, the circulation condition-monitoring equipment which generates alarm is known. For example, in order to detect an electrocardio guidance wave as a heartbeat synchronization voltage, a living body's predetermined part is equipped with two or more electrodes with which electrocardio signal-detection equipment (heartbeat synchronization-voltage detection equipment) was equipped, arrhythmia is automatically diagnosed based on the electrocardiogram measured by the electrocardio signal-detection equipment, and when it judges with arrhythmia having occurred, the equipment which generates alarm is known.

[0003] When arrhythmia occurs, it is made to have alarm generated since arrhythmia may express aggravation of a patient's circulation condition. However, alarm may be generated although a patient's circulation condition is not getting worse if alarm is generated with an arrhythmic chisel since arrhythmia may not necessarily express aggravation of a patient's circulation condition. Moreover, even if alarm is generated, when the case where a patient's circulation condition is not getting worse occurs frequently, alarm may be turned off in a medical site. However, since arrhythmia may have occurred based on aggravation of a patient's circulation condition, it is not desirable to turn off alarm.

[0004]

[Problem(s) to be Solved by the Invention] By the way, a patient's circulation condition can be supervised also by supervising blood pressure. Then, when arrhythmic generating is supervised continuously and arrhythmia occurs, the automatic blood-pressure supervisory equipment which measures blood pressure automatically is proposed. For example, the automatic blood-pressure-measurement equipment indicated by JP,64-56206,U is it. When judged with arrhythmia having occurred according to this automatic blood-pressure-measurement equipment, a blood-pressure value is measured automatically, and it is judged whether it is within limits as which the blood-pressure value was determined beforehand. That is, since a patient's circulation condition can be judged based on arrhythmia and a blood-pressure value, a patient's circulation condition can be judged comparatively correctly.

[0005] However, immediate steps may be needed, even if it is the blood-pressure value made into a normal range, when arrhythmia has occurred and arrhythmia has not occurred. That is, even if it was the case where it was not judged with it being unusual with the automatic blood-pressure-measurement equipment indicated by the above-mentioned official report, the automatic blood-pressure-measurement equipment of the judgment precision of a patient's circulation condition with which a circulation state is

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[0003] When arrhythmia occurs, it is made to have alarm generated since arrhythmia may express aggravation of a patient's circulation condition. However, alarm may be generated although a patient's circulation condition is not getting worse if alarm is generated with an arrhythmic chisel since arrhythmia may not necessarily express aggravation of a patient's circulation condition. Moreover, even if alarm is generated, when the case where a patient's circulation condition is not getting worse occurs frequently, alarm may be turned off in a medical site. However, since arrhythmia may have occurred based on aggravation of a patient's circulation condition, it is not desirable to turn off alarm.

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[0005] However, immediate steps may be needed, even if it is the blood-pressure value made into a normal range, when arrhythmia has occurred and arrhythmia has not occurred. That is, even if it was the case where it was not judged with it being unusual with the automatic blood-pressure-measurement equipment indicated by the above-mentioned official report, the automatic blood-pressure-measurement equipment of the judgment precision of a patient's circulation condition with which a circulation state is

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unusual, may need immediate steps, and was indicated to be by the above-mentioned official report in fact was inadequate.

[0006] Succeeding in this invention against the background of the above situations, the place made into the purpose is to offer the circulation condition-monitoring equipment which can judge a patient's circulation condition correctly.

[0007]

[Means for Solving the Problem] When arrhythmia had occurred paying attention to change of blood pressure being large when it is based unusually [a circulation state] and arrhythmia has occurred, as a result of repeating examination variously, in order to attain the above-mentioned purpose, and change of the blood pressure was large and it judged with a circulation state being unusual even if blood pressure had not become outlying observation, it found out that the abnormalities of a circulation state could be judged more to accuracy. Moreover, when arrhythmia had occurred, it found out that the abnormalities of a circulation state could be judged correctly also by setting the reference value which judges the abnormalities in blood pressure to a normal-values side rather than the time of arrhythmia not occurring.

[0008]

[The 1st means for solving a technical problem] Namely, the place made into the summary of the 1st invention for attaining the above-mentioned purpose The heartbeat synchronization-voltage detection equipment with which a living body is equipped and which detects the living body's heartbeat synchronization voltage, It has an arrhythmic judging means to judge arrhythmia based on the heartbeat synchronization voltage detected by the heartbeat synchronization-voltage detection equipment. It is circulation condition-monitoring equipment which supervises the state where blood circulates in the living body. (a) A 1st blood-pressure determination means to determine the living body's 1st blood-pressure value based on the pulse wave generated in process in which carry out the hemostasis of the part by the cuff wound around the aforementioned living body's predetermined part, and **** pressure lowering of the compression pressure force of the cuff is carried out continuously, (b) A blood-pressure related information determination means to determine serially the blood-pressure related information changed in relation to the aforementioned living body's blood pressure based on the pulse wave detected without carrying out the hemostasis of the part with the pulse wave detection equipment with which the aforementioned living body's predetermined part is equipped, (c) A correspondence relation determination means to determine the correspondence relation between the 1st blood-pressure values determined by the blood-pressure related information and the aforementioned 1st blood-pressure determination means which were serially determined by the blood-pressure related information determination means, (d) A 2nd blood-pressure determination means to determine serially the aforementioned living body's 2nd blood-pressure value based on the blood-pressure related information serially determined by the aforementioned blood-pressure related information determination means using the correspondence relation determined by the correspondence relation determination means, (e) A change value calculation means to compute serially the 2nd blood-pressure value-change value determined by the 2nd blood-pressure determination means, (f) It is in the aforementioned living body's circulation condition including an unusual judging means to judge with it being unusual, based on the change value which was judged as arrhythmia having occurred by the aforementioned arrhythmic judging means, and was computed by the aforementioned change value calculation means having exceeded the criterion value set up beforehand.

[0009]

[The 1st effect of the invention] If it does in this way, the 2nd blood-pressure value-change value determined by the 2nd blood-pressure determination means will be computed by the change value calculation means. by the unusual judging means Since it judges that a circulation state is unusual based on having exceeded the criterion value to which the change value which was judged as arrhythmia having occurred by the arrhythmic judging means, and was computed by the change value calculation means was set beforehand, a circulation state is judged correctly. In addition, since blood-pressure related information is determined based on the pulse wave detected without carrying out the hemostasis

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of the living body with pulse wave detection equipment and the 2nd blood-pressure value is determined based on the blood-pressure related information, whenever it is judged with arrhythmia having occurred, there is no un-arranging [of carrying out the hemostasis of some living bodies, and giving a patient pain].

[0010]

[Other modes of the 1st invention] Suitably here the aforementioned circulation condition-monitoring equipment When it has further the input unit which inputs the hypotensive patient signal showing being a hypotensive patient and the hypotensive patient signal is inputted from the aforementioned input unit It is judged with arrhythmia having generated the aforementioned unusual judging means by the aforementioned arrhythmic judging means. And at least one side of the 2nd blood-pressure value determined by the change value and the aforementioned 2nd blood-pressure determination means which were computed by the above-mentioned change value calculation means judges with the aforementioned living body's circulation condition being unusual based on having exceeded the criterion value beforehand set up about each. Although blood pressure may be falling so that he needs immediate steps, even if blood pressure is a low also in the normal state and a hypotensive patient does not have a so large change of blood pressure When doing in this way, and the hypotensive patient signal was beforehand inputted from the input unit and it is judged with arrhythmia having occurred It is based on having exceeded the criterion value to which at least one side of the 2nd blood-pressure value determined by 2 blood-pressure value determination means was beforehand set about each. the [the change value computed by the change value calculation means by the unusual judging means, and] -- Since it judges that a circulation state is unusual, even if it is a hypotensive patient, the abnormalities of a circulation state are judged certainly.

[0011]

[The 2nd means for solving a technical problem] Moreover, the place made into the summary of the 2nd invention for attaining the aforementioned purpose The heartbeat synchronous wave detection equipment with which a living body is equipped and which detects the living body's heartbeat synchronous wave, It has an arrhythmic judging means to judge an irregular pulse based on the heartbeat synchronous wave detected by the heartbeat synchronous wave detection equipment. It is circulation condition-monitoring equipment which supervises the state where blood circulates in the living body [aforementioned]. (a) A blood-pressure-measurement means to measure the living body's blood-pressure value based on the pulse wave generated in the process of the compression pressure force of the cuff using the cuff wound around the aforementioned living body's predetermined part, (b) A change value calculation means to compute serially the blood-pressure value-change value determined by the blood-pressure-measurement means, (c) When judged with the irregular pulse having occurred by the aforementioned arrhythmic judging means The aforementioned blood-pressure-measurement means and the aforementioned change value calculation means are performed, and it is in the aforementioned living body's circulation condition including an unusual judging means to judge with it being unusual, based on the change value computed by the change value calculation means having exceeded the criterion value set up beforehand.

[0012]

[The 2nd effect of the invention] Based on having exceeded the criterion value to which the blood-pressure value was measured by the blood-pressure-measurement means when judged with the irregular pulse having occurred by the arrhythmic judging means with the unusual judging means when doing in this way, the blood-pressure value-change value was computed by the change value calculation means, and the change value was set further beforehand, it is judged with a circulation state being unusual. That is, since it judges that the abnormalities of a living body's circulation condition are arrhythmic based on change of blood pressure, a circulation state is judged correctly.

[0013]

[Other modes of the 2nd invention] Suitably here the aforementioned circulation condition-monitoring equipment When it has further the input unit which inputs the hypotensive patient signal showing being a hypotensive patient and the hypotensive patient signal is inputted from the aforementioned input unit

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When judged with arrhythmia having generated the aforementioned unusual judging means by the aforementioned arrhythmic judging means Perform the aforementioned blood-pressure-measurement means and the above-mentioned change value calculation means, and it is based on having exceeded the criterion value to which at least one side of the blood-pressure value measured by the change value computed by the change value calculation means and its blood-pressure-measurement means was beforehand set about each. It judges with the aforementioned living body's circulation condition being unusual. When doing in this way, and the hypotensive patient signal was beforehand inputted from the input unit and it is judged with arrhythmia having occurred It is based on having exceeded the criterion value to which at least one side of the blood-pressure value measured by the change value and blood-pressure-measurement means which were computed by the change value calculation means by the unusual judging means was beforehand set about each. Since it judges that a circulation state is unusual, the abnormalities of a circulation state are judged more certainly.

[0014]

[The 3rd means for solving a technical problem] Moreover, the place made into the summary of the 3rd invention for attaining the aforementioned purpose The heartbeat synchronization-voltage detection equipment with which a living body is equipped and which detects the living body's heartbeat synchronization voltage, An arrhythmic judging means to judge arrhythmia based on the heartbeat synchronization voltage detected by the heartbeat synchronization-voltage detection equipment, It is circulation condition-monitoring equipment which supervises the state where blood circulates in the living body. (a) A blood-pressure-measurement means to measure the living body's blood-pressure value based on the pulse wave generated in the process of the compression pressure force of the cuff using the cuff wound around the aforementioned living body's predetermined part, (b) A 1st abnormality judging means to judge with the aforementioned living body's circulation condition being unusual based on being below the 1st criteria blood-pressure value to which the blood-pressure value determined by the blood-pressure-measurement means was set beforehand, (c) When judged with arrhythmia having occurred by the aforementioned arrhythmic judging means The aforementioned blood-pressure-measurement means is performed and it is in the aforementioned living body's circulation condition including a 2nd abnormality judging means to judge with it being unusual, based on the blood-pressure value determined by the blood-pressure-measurement means being below the 2nd criteria blood-pressure value beforehand set as the larger value than the aforementioned 1st criteria blood-pressure value.

[0015]

[The 3rd effect of the invention] If it does in this way, based on being below the 1st criteria blood-pressure value to which the blood-pressure value measured by the blood-pressure-measurement means was set beforehand, the abnormalities of a living body's circulation condition will be judged by the 1st abnormality judging means. moreover, when judged with arrhythmia having occurred by the arrhythmic judging means with the 2nd abnormality judging means when the abnormalities of a circulation state were not judged by the 1st abnormality judging means A blood-pressure value is measured by the blood-pressure-measurement means, and since the abnormalities of a living body's circulation condition are judged based on being below the 2nd criteria blood-pressure value with which the blood-pressure value was beforehand set as the larger value than the aforementioned 1st criteria blood-pressure value, the abnormalities of a circulation state are judged correctly.

[0016]

[The 4th means for solving a technical problem] Moreover, the place made into the summary of the 4th invention for attaining the aforementioned purpose The heartbeat synchronization-voltage detection equipment with which the aforementioned living body is equipped and which detects the living body's heartbeat synchronization voltage, It has an arrhythmic judging means to judge arrhythmia based on the heartbeat synchronization voltage detected by the heartbeat synchronization-voltage detection equipment. It is circulation condition-monitoring equipment which supervises the state where blood circulates in the living body. (a) A 1st blood-pressure determination means to determine the living body's 1st blood-pressure value based on the pulse wave generated in process in which carry out the hemostasis of the part by the cuff wound around the aforementioned living body's predetermined part,

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and **** pressure lowering of the compression pressure force of the cuff is carried out continuously, (b) Pulse wave machine ***** detected without carrying out the hemostasis of the part with the pulse wave detection equipment with which the aforementioned living body's predetermined part is equipped, and a blood-pressure related information determination means to determine serially the blood-pressure related information changed in relation to the aforementioned living body's blood pressure, (c) A correspondence relation determination means to determine the correspondence relation between the 1st blood-pressure values determined by the blood-pressure related information and the aforementioned 1st blood-pressure determination means which were serially determined by the blood-pressure related information determination means, (d) A 2nd blood-pressure determination means to determine serially the aforementioned living body's 2nd blood-pressure value based on the blood-pressure related information serially determined by the aforementioned blood-pressure related information determination means using the correspondence relation determined by the correspondence relation determination means, (e) A 1st abnormality judging means to judge with the aforementioned living body's circulation condition being unusual based on being below the 1st criteria blood-pressure value to which the 2nd blood-pressure value determined by the 2nd blood-pressure determination means was set beforehand, (f) It is judged with arrhythmia having occurred by the aforementioned arrhythmic judging means. It is in the aforementioned living body's circulation condition including a 2nd abnormality judging means to judge with it being unusual, based on the 2nd blood-pressure value determined by the aforementioned 2nd blood-pressure determination means being below the 2nd criteria blood-pressure value beforehand set as the larger value than the aforementioned 1st criteria blood-pressure value.

[0017]

[The 4th effect of the invention] If it does in this way, based on being below the 1st criteria blood-pressure value to which the 1st blood-pressure value determined by the 1st blood-pressure determination means was set beforehand, the abnormalities of a living body's circulation condition will be judged by the 1st abnormality judging means. When the abnormalities of a circulation state are not judged by the 1st abnormality judging means, moreover, by the 2nd abnormality judging means Since it judges that a circulation state is unusual based on being below the 2nd criteria blood-pressure value with which the 2nd blood-pressure value which was judged as arrhythmia having occurred by the arrhythmic judging means, and was determined by the 2nd blood-pressure determination means was beforehand set as the larger value than the aforementioned 1st criteria blood-pressure value A circulation state is judged correctly. In addition, since blood-pressure related information is determined based on the pulse wave detected without carrying out the hemostasis of the living body with pulse wave detection equipment and the 2nd blood-pressure value is determined based on the blood-pressure related information, whenever it is judged with arrhythmia having occurred, un-arranging [of carrying out the hemostasis of some living bodies, and giving a patient pain] is canceled.

[0018]

[Other modes of invention] Here, in the circulation condition-monitoring equipment concerning the 1st invention of the above, or the 4th invention, the aforementioned heartbeat synchronization-voltage detection equipment is electrocardio signal-detection equipment which is equipped with two or more electrodes with which the aforementioned living body's predetermined part is equipped, and detects an electrocardio calling-on signal through the electrode suitably. If it does in this way, the electrocardio calling-on signal detected by electrocardio signal-detection equipment is the so-called electrocardiogram, and since arrhythmia is judged based on the electrocardiogram, the arrhythmia of various kinds can be judged with an arrhythmic judging means.

[0019] Moreover, suitably, in the circulation condition-monitoring equipment concerning the 1st invention of the above, or the 4th invention, the aforementioned heartbeat synchronization-voltage detection equipment detects the heartbeat synchronization voltage generated in the cuff, when the compression pressure force of the cuff is made into the compression pressure force lower enough than a lowest-blood-pressure value set up beforehand including the aforementioned cuff. If it does in this way, since a heartbeat synchronization voltage will be detected using the cuff for blood pressure measurement, composition becomes easy and circulation condition-monitoring equipment becomes

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cheap.

[0020]

[The gestalt of suitable implementation of invention] Hereafter, the gestalt of operation of this invention is explained in detail based on a drawing. Drawing 1 is a block diagram explaining the composition of the circulation condition-monitoring equipment 8 with which this invention was applied.

[0021] Circulation condition-monitoring equipment 8 is equipped with the cuff 10 which has rubber bag manufacture in the band-like bag made of cloth, for example, is wound around a patient's overarm section 12, and the pressure sensor 14 connected to this cuff 10 through piping 20, respectively, a pressure control valve 16 and an air pump 18 in drawing 1. The above-mentioned pressure control valve 16 is constituted so that it may be switched to three states, the pressure supply state of permitting supply of the pressure into a cuff 12, the **** exhaust-gas-pressure state which carries out exhaust gas pressure of the inside of a cuff 12 gradually, and the rapid exhaust-gas-pressure state which carries out exhaust gas pressure of the inside of a cuff 12 quickly.

[0022] A pressure sensor 14 supplies the pressure signal SP with which the pressure in a cuff 10 is detected and the pressure is expressed to the static pressure discriminator 22 and the pulse wave discriminator 24, respectively. The static pressure discriminator 22 is, the steady pressure, i.e., cuff pressure PC, which is equipped with a low pass filter and contained in the pressure signal SP. It discriminates from the cuff pressure signal SK to express, and the cuff pressure signal SK is supplied to an electronic control 28 through A/D converter 26.

[0023] It is the cuff pulse wave signal SM 1 which the above-mentioned pulse wave discriminator 24 is equipped with a band pass filter, and is the oscillating component of the pressure signal SP. It discriminates in frequency and is the cuff pulse wave signal SM 1. An electronic control 28 is supplied through A/D converter 29. This cuff pulse wave signal SM 1 The cuff pulse wave to express is a brachial-artery wave which occurs from the brachial artery which is not illustrated synchronizing with a patient's heartbeat, and is transmitted to a cuff 10.

[0024] The above-mentioned electronic control 28 consists of so-called microcomputers equipped with CPU30, ROM32, RAM34, the I/O Port that is not illustrated, and CPU30 controls the content of a display of a drop 36 while judging a patient's circulation condition by performing signal processing, using the storage function of RAM34 for ROM32 according to the program memorized beforehand.

[0025] The photoelectrical pulse wave sensor 40 which functions as plethysmogram detection equipment does not detect the plethysmogram (pre SHISUMO graph) of a living body's peripheral vessel, and the finger-tip section of the near arm around which the cuff 10 is not wound is equipped with it. This photoelectrical pulse wave sensor 40 is constituted like what is used for pulse detection etc. Red light or infrared light of a wavelength range which can be reflected by hemoglobin in the housing 42 which can hold some living bodies, such as the finger-tip section The light emitting device 44 which is the light source which irradiates preferably the wavelength of about 800nm which is not influenced toward a living body's epidermis by the saturation of oxygen, Photoelectrical pulse wave signal SM 2 corresponding to [it is prepared in the side which counters the light emitting device 44 of housing 42, have the photo detector 46 which detects the light which has penetrated some above-mentioned living bodies, and] the blood capacity in a capillary It outputs and an electronic control 28 is supplied through A/D converter 48.

[0026] Electrocardio signal-detection equipment 50 is equipped with two or more electrodes 52 stuck and stuck to a living body's predetermined part, detects continuously the electrocardio guidance wave which shows the action potential of a myocardium through the electrode 52, and the so-called electrocardiogram, and supplies the electrocardio calling-on signal SE which shows the electrocardio guidance wave to the aforementioned electronic control 28 through A/D converter 54. Since the above-mentioned electrocardio guidance wave is a heartbeat synchronization voltage generated synchronizing with a heartbeat, electrocardio signal-detection equipment 50 functions as heartbeat synchronization-voltage detection equipment.

[0027] A transfer switch 56 functions as an input unit in this example, and is constituted possible [a switch in two positions, the position which outputs the hypotensive patient signal showing a patient

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being a hypotensive patient, and the position which outputs the signal showing a patient not being a hypotensive patient,]. Although switch operation is beforehand carried out in advance of the surveillance of a circulation state when a patient is judged to be a hypotensive patient by a doctor's etc. judgment, when a patient is not a hypotensive patient, even if this transfer switch 56 is located in this transfer switch 56 by the position which outputs a hypotensive patient signal, it does not interfere. In addition, also in the healthy state, a hypotensive patient has a low highest-blood-pressure value, for example, points out the patient whose highest-blood-pressure value is 100 or less mmHg.

[0028] Drawing 2 is a functional block diagram explaining the important section of the control function of the above-mentioned electronic control 28. In drawing, the blood-pressure-measurement means 60 carries out the rapid pressure up of the pressure in a cuff 12 by functioning also as a 1st blood-pressure determination means, and making an air pump 18 drive first, and changing a pressure control valve 16 to a pressure supply state. It is based on the cuff pressure signal SK from which it is discriminated by the static pressure discriminator 22. the compression pressure force of a cuff 12 And the predetermined target prepressure force value PCM higher than a highest-blood-pressure value By changing a pressure control valve 16 to a **** exhaust-gas-pressure state continuously, when it judges with having reached (for example, the pressure value of about 180 mmHg) **** pressure lowering of the compression pressure force of a cuff 12 is carried out at the speed beforehand set as about 3 mmHg/sec. the oscillometric method which was easy to be based on change of the amplitude of the pulse wave which the cuff pulse wave signal SM 1 extracted one by one in the **** pressure-lowering process expresses, and was known -- using -- the highest-blood-pressure value BPSYS, the average blood-pressure value BPMEAN, and lowest-blood-pressure value BPDIA etc. -- it determines

[0029] The pulse-wave-velocity information calculation means 62, predetermined part, for example, R wave, generated for every electrocardio guidance wave period serially detected by electrocardio signal-detection equipment 50 as shown in drawing 3 It has a time difference calculation means to compute serially the time difference (pulse wave propagation time) DTRP to the predetermined part, for example, the standup point, or predetermined lower peak point generated for every period of the photoelectrical pulse wave serially detected by the photoelectrical pulse wave sensor 40. Based on the time difference DTRP serially computed by the time difference calculation means, the propagation velocity PWV (m/sec) of the pulse wave which spreads the inside of the artery of an operating personnel-ed is serially computed from the formula 1 memorized beforehand. Changing these pulse wave propagation time DT or pulse wave velocity PWV in relation to a living body's blood pressure is known. That is, pulse-wave-velocity information is blood-pressure related information, and the pulse-wave-velocity information calculation means 62 functions as a blood-pressure related information determination means. In addition, L (m) is the distance to the part equipped with the aforementioned photoelectrical pulse wave sensor 40 through an aorta in a formula 1 from the ventriculus sinister, and is TPEP (sec). It is a precursive appearance period from the R wave of an electrocardio guidance wave to the lower peak point of an aorta origin section pulse wave. Such distance L and precursive appearance period TPEP It is a constant and the value beforehand calculated based on the experiment is used.

(Formula 1) $VM = L / (DTRP - TPEP)$

[0030] A presumed blood-pressure value calculation means 64 to function as a 2nd blood-pressure determination means The correspondence relational expression of the pulse-wave-velocity information and the presumed blood-pressure value EBP which were determined beforehand, For example, based on pulse-wave-velocity information, such as the pulse wave propagation time DTRP actually serially computed by the pulse-wave-velocity information calculation means 62 or pulse wave velocity PWV, the presumed blood-pressure value EBP is serially computed using the correspondence relational expression shown in a formula 2 or a formula 3. The computed presumed blood-pressure value EBP is memorized one by one to the storage region which RAM34 does not illustrate. in addition, in a formula 2 and a formula 3, the pulse wave propagation time DTRP becomes small, so that alpha, alpha', beta, and beta' is a constant and blood pressure becomes high (that is, $1/DTRP$ becomes large) -- it is -- since pulse wave velocity PWV becomes large so that a constant alpha serves as a positive value and blood pressure becomes high, constant alpha' becomes a positive value

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(Formula 2) $EBP = \alpha(1/DTRP) + \beta$ (formula 3) $EBP = \alpha'PWV + \beta'$ [0031] The correspondence relation determination means 66 is the highest-blood-pressure value BPSYS measured by the blood-pressure-measurement means 60. Based on the pulse-wave-velocity information at the time of the blood pressure measurement (namely, just before the blood-pressure-measurement period within a blood-pressure-measurement period or immediately after), the constant of the above-mentioned correspondence relational expression is determined. For example, based on the pulse wave propagation time DTRP computed by the pulse-wave-velocity information calculation means 62 within the blood-pressure-measurement period, the constant of the relation set up beforehand shown in the above-mentioned formula 2 is determined. The method of the constant determination in this case is the highest-blood-pressure value BPSYS measured by the blood-pressure-measurement means 60. Either of the constants α and β of the above-mentioned formula 2 is beforehand determined using the pulse wave propagation time DTRP computed at the time of the above-mentioned blood pressure measurement (change). Or highest-blood-pressure value BPSYS measured by the blood-pressure-measurement means 60 Highest-blood-pressure value BPSYS which made the lot the pulse wave propagation time DTRP computed at the time of the above-mentioned blood pressure measurement, and was acquired at the time of the last blood pressure measurement It is already beforehand determined by making the pulse wave propagation time DTRP into a lot that constants α and β will fill 2 sets of the relations. In addition, the above-mentioned highest-blood-pressure value BPSYS The average blood-pressure value BPMEAN which replaced with and was measured by the blood-pressure-measurement means 60, or lowest-blood-pressure value BPDIA It may be used. It is chosen by whether in short, the presumed blood-pressure value EBP is made into a highest-blood-pressure value, it considers as an average blood-pressure value, or it considers as a lowest-blood-pressure value.

[0032] The change value calculation means 68 computes change value ΔEBP of the presumed blood-pressure value EBP serially computed by the presumed blood-pressure value calculation means 64. Rate of change of the presumed blood-pressure value EBP serially computed with change value ΔEBP here (%) Or it is variation (mmHg). For example, rate of change or variation to the moving average EBP_{AV} of between the number of predetermined beats of the presumed blood-pressure value EBP (for example, 20 beats or about 30 beats), or a predetermined time (30 seconds or about several minutes), Or it is the rate of change or variation to the presumed blood-pressure value EBP in front of the presumed blood-pressure value EBP when blood pressure measurement is performed by the blood-pressure-measurement means 60 last time, a predetermined time, or the number of predetermined beats (for example, ten quotas).

[0033] The arrhythmic judging means 70 judges arrhythmic generating according to the arrhythmic judging algorithm which could be based on the electrocardio calling-on signal SE supplied from electrocardio signal-detection equipment 50, and was known. It judges with arrhythmia having generated the above-mentioned arrhythmic judging algorithm, when the configuration of an electrocardio guidance wave when [normal] the electrocardio guidance wave which for example, the electrocardio calling-on signal SE expresses is memorized beforehand is compared, and it judges, and the flat part (S-T level) of the S-T section in the detected electrocardio guidance wave goes up or descended and differed exceeding the configuration and fixed range at the time of normal [above-mentioned], or when the ventricular extrasystole occurred. In addition, the multiple ventricle premature contraction which the premature contraction generates 5 or 6 times or more in 1 minute in the above-mentioned ventricular extrasystole, The R-on-T type premature contraction generated as the R wave of the premature contraction laps on the T wave of the last normal wave, There is show tolan type premature contraction which 3 or 4 or more ventricular extrasystole stands in a row, and is generated, and comparison with a configuration when [normal] the detected electrocardio guidance wave is memorized beforehand detects these ventricular extrasystole. Moreover, it is based on an electrocardio guidance wave besides elevation and descent of the above S-T level, and detection of the ventricular extrasystole, and is a cardiac cycle TP. It determines and is the cardiac cycle TP. The unusually short tachycardia and cardiac cycle TP Arrhythmia, such as an unusually long bradycardia, is also judged.

[0034] When it is judged with arrhythmia having generated the unusual judging means 72 by the above-

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mentioned arrhythmic judging means 70 and is judged with the arrhythmia having occurred, change value deltaEBP computed by the aforementioned change value calculation means 68 judges with a patient's circulation condition being unusual based on having exceeded the criterion value TH (delta) set up beforehand. And when it judges with a circulation state being unusual, in order to measure the reliable blood-pressure value BP, the aforementioned blood-pressure-measurement means 60 is performed. Change value deltaEBP computed when judged with the above-mentioned arrhythmia having occurred means change value deltaEBP computed immediately after judging with the newest thing or arrhythmia having occurred among change value deltaEBP(s) already computed when judged with arrhythmia having occurred. The above-mentioned criterion value TH (delta) is a value beforehand determined based on the experiment, and when change value deltaEBP is rate of change, when change value deltaEBP is variation, it is set to 20 - 30mmHg 20 to 30%. In addition, although the above-mentioned change value deltaEBP serves as a negative value when the presumed blood-pressure value EBP is falling, in this unusual judging means 72, it judges with an absolute value. That is, when arrhythmia occurs, blood pressure is rising and blood pressure is in a fall inclination, the abnormalities of a circulation state may be judged.

[0035] moreover, when the hypotensive patient signal from the aforementioned transfer switch 56 is supplied It is judged with arrhythmia having generated the unusual judging means 72 by the arrhythmic judging means 70. And the criterion value TH (delta) to which at least one side of the presumed blood-pressure value EBP computed by aforementioned presumed blood-pressure value ***** 64 when change value deltaEBP computed by the change value calculation means 68 and its arrhythmia occurred was beforehand set about each, Based on having exceeded TH (BP), it judges with a patient's circulation condition being unusual. The criterion value TH about the presumed blood-pressure value EBP (BP) is set as 80 - 90mmHg, when the presumed blood-pressure value EBP expresses the highest-blood-pressure value. Since blood pressure may be falling so that immediate steps are needed in the case of a hypotensive patient, even if it is the case where the blood-pressure value BP is a low, and change value deltaEBP of the presumed blood-pressure value EBP does not exceed the above-mentioned criterion value TH (delta) in the normal state, either, since change of blood pressure is not so large, an absolute value judges with a circulation state being unusual also to a low case.

[0036] The unusual display means 74 displays a display to that effect on a drop 36, when it judges that a patient's circulation condition is unusual by the above-mentioned unusual judging means 72.

[0037] Drawing 4 is a flow chart which explains still more concretely the important section of a control operation of the above-mentioned electronic control 28, and is a correspondence relation determination routine performed in order to determine the correspondence relational expression used for calculation of the presumed blood-pressure value EBP. First, when initial processing which clears Timer t and a register in the step SA 1 (a step is skipped hereafter.) of drawing is performed, and a change-over valve 16 is switched to a pressure supply state in continuing SA2 and an air pump 18 drives, the rapid pressure up of a cuff 10 is started for blood pressure measurement.

[0038] Subsequently, in SA3 corresponding to the pulse-wave-velocity information calculation means 64, the time difference of the time of the standup point of a photoelectrical pulse wave being detected by the photoelectrical pulse wave sensor 40 from the time of an R wave, the pulse wave propagation time DTRP, i.e., the electrocardio guidance wave, shown also in drawing 3, being detected is computed.

[0039] At continuing SA4, it is cuff pressure PC. It is judged whether it became more than the target compression pressure PCM beforehand set as about 180 mmHgs. It is cuff pressure PC by performing judgment of SA4 repeatedly, when judgment of this SA4 is denied. Elevation is continued. However, cuff pressure PC If judgment of the above SA 4 is affirmed by elevation, by continuing SA5, an air pump 18 is suspended, a pressure control valve 16 will be switched to a **** exhaust-gas-pressure state, and the pressure in a cuff 10 will begin to be dropped at a loose speed which is about 3 mmHg/sec defined beforehand at SA6.

[0040] Cuff pulse wave signal SM 1 serially acquired in the **** pressure-lowering process in continuing SA7 Based on change of the amplitude of the pulse wave to express, the blood-pressure value decision algorithm of an oscillograph metric method known well is followed, and they are the

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highest-blood-pressure value BPSYS, the average blood-pressure value BPMEAN, and the lowest-blood-pressure value BPDIA. It is determined one by one. And lowest-blood-pressure value BPDIA If determined, in continuing SA8, a pressure control valve 16 will be switched to a rapid exhaust-gas-pressure state, and exhaust gas pressure of the inside of a cuff 10 will be carried out quickly. Therefore, the above SA2, SA4-SA8 corresponds to the blood-pressure-measurement means 60.

[0041] Then, SA9 corresponding to the aforementioned correspondence relation determination means 66 is performed. Namely, highest-blood-pressure value BPSYS determined by the pulse wave propagation time DTRP computed by the above SA 3 in this routine, and the above SA 7 The pulse wave propagation time DTRP which considered as the lot and was determined in the last routine, and highest-blood-pressure value BPSYS As other lots, the constants alpha and beta of the aforementioned formula 2 are determined. In addition, when this correspondence relation determination routine is first performed in the during starting of circulation condition-monitoring equipment 8, the general value calculated statistically is used for either of the constants alpha and beta.

[0042] Drawing 5 is also the flow chart which explains still more concretely the important section of a control operation of the aforementioned electronic control 28, and is the circulation condition-monitoring routine performed following the correspondence relation determination routine of drawing 4 . In addition, the circulation condition-monitoring routine shown in drawing 5 is a circulation condition-monitoring routine for hypotensive patients performed when the hypotensive signal from a transfer switch 56 is supplied.

[0043] First, photoelectrical pulse wave signal SM 2 continuously supplied in SB1 from the photoelectrical pulse wave sensor 40 and electrocardio signal-detection equipment 50 It is the photoelectrical pulse wave signal SM 2 whether it reached and the electrocardio calling-on signal SE was inputted by one beat. It is judged based on whether the peak of a photoelectrical pulse wave to express was detected. When this judgment of SB1 is denied, judgment of SB1 is repeated and it is the photoelectrical pulse wave signal SM 2 to the meantime. And the electrocardio calling-on signal SE is supplied further.

[0044] On the other hand, when judgment of the above SB1 is affirmed, the time difference DTRP of the time of the standup point of the above-mentioned photoelectrical pulse wave being detected in SB2 corresponding to the continuing pulse-wave-velocity information calculation means 62 from the time of the R wave of the electrocardio guidance wave being detected based on the newest photoelectrical pulse wave and newest electrocardio guidance wave for one beat which were inputted by the above SB1, i.e., the pulse wave propagation time, is computed.

[0045] In SB3 corresponding to the continuing presumed blood-pressure value calculation means 64, by substituting the pulse wave propagation time DTRP determined in the above SB2 for the formula 2 as which constants alpha and beta were determined in SA9 of drawing 4 , the presumed blood-pressure value EBP is computed and the computed presumed blood-pressure value EBP is memorized by the predetermined storage region of RAM34.

[0046] It is judged by comparing the electrocardio guidance wave which the electrocardio calling-on signal SE of the predetermined section containing the electrocardio calling-on signal SE inputted in the above SB1 expresses with SB4 corresponding to the continuing arrhythmic judging means 70 with the normal electrocardio guidance wave memorized beforehand whether arrhythmia occurred or not.

[0047] In SB5 corresponding to the change value calculation means 68 which continues when judgment of the above SB4 is affirmed The rate of change (%) to the presumed blood-pressure value EBP computed with the above SB3 immediately after performing a correspondence relation determination routine last time [of the presumed blood-pressure value EBP computed by the SB3] as change value deltaEBP of the presumed blood-pressure value EBP computed with the above SB3 is computed.

[0048] Then, SB6 corresponding to the unusual judging means 74 or SB7 is performed. First, in SB6, it is judged whether the presumed blood-pressure value EBP computed with the above SB3 is smaller than 80mmHg(s) beforehand set up as a criterion value TH (BP). When this judgment is denied, in continuing SB7, it is judged whether change value deltaEBP computed by the above SB5 is larger than 20% beforehand set up as a criterion value TH (delta). When judgment of the above SB6 is affirmed, or

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when judgment of the above SB7 is affirmed, in SB8 corresponding to the continuing unusual display means 74, the purport that a circulation state is unusual is indicated to a drop 36, in order to acquire a more reliable blood-pressure value after that, the correspondence relation determination routine of drawing 4 is performed, and blood pressure measurement by the cuff 10 is performed.

[0049] On the other hand, when judgment of the above SB4 is denied, or when judgment of the above SB7 is denied, it is judged whether it passed in SB9, the setting period, i.e., the calibration period, which is 15 to which the elapsed time after the correspondence relation determination routine of drawing 4 is performed was set beforehand, or about 20 minutes. When this judgment of SB9 is denied, an one or less above [SB] circulation condition-monitoring routine is performed repeatedly, and when judgment of SB9 is affirmed, in order to re-determine the correspondence relation of the aforementioned formula 2, the correspondence relation determination routine of drawing 4 is performed again.

[0050] According to the gestalt of operation mentioned above, by the change value calculation means 68 (SB5) Change value ΔEBP of the presumed blood-pressure value EBP computed by the presumed blood-pressure value calculation means 64 (SB3) is computed. by the unusual judging means 72 (SB [6] or SB7) It is judged with arrhythmia having occurred by the arrhythmic judging means 70 (SB4). And since it judges that a circulation state is unusual when change value ΔEBP computed by the change value calculation means 68 (SB5) exceeds the criterion value TH (Δ) set up beforehand, a circulation state is judged correctly. In addition, since the pulse wave propagation time DTRP is determined by the photoelectrical pulse wave sensor 40 and electrocardio signal-detection equipment 50 based on the photoelectrical pulse wave and electrocardio guidance wave which were detected without carrying out the hemostasis of the living body and the presumed blood-pressure value EBP is determined based on the pulse wave propagation time DTRP, whenever it is judged with arrhythmia having occurred, un-arranging [of carrying out the hemostasis of some living bodies, and giving a patient pain] is canceled. [0051] moreover, when according to the gestalt of above-mentioned operation the hypotensive patient signal was beforehand inputted from the transfer switch 56 and it is judged with arrhythmia having occurred The criterion value TH (Δ) to which at least one side of the presumed blood-pressure value EBP computed by change value ΔEBP and the presumed blood-pressure value calculation means 64 (SB3) which were computed by the change value calculation means 68 (SB5) by the unusual judging means 72 (SB [6] or SB7) was beforehand set about each, Since it judges that a circulation state is unusual when TH (BP) is exceeded, even if it is a hypotensive patient, the abnormalities of a circulation state are judged certainly.

[0052] Moreover, according to the gestalt of above-mentioned operation, electrocardio signal-detection equipment 50 is used as heartbeat synchronization-voltage detection equipment. The electrocardio calling-on signal SE detected by this electrocardio signal-detection equipment 50 is the so-called electrocardiogram, and with the arrhythmic judging means 70 (SB4), since arrhythmia is judged based on the electrocardiogram, the arrhythmia of various kinds can be judged.

[0053] Next, the gestalt of other operations of this invention is explained. In addition, the portion which is common in the above-mentioned operation gestalt in the following explanation attaches the same sign, and omits detailed explanation.

[0054] Drawing 6 is a functional block diagram explaining the important section of the control function of the electronic control 28 in the circulation condition-monitoring equipment 75 with which this invention was applied. In addition, the points that this circulation condition-monitoring equipment 75 differs from the above-mentioned circulation condition-monitoring equipment 8 are only not having the photoelectrical pulse wave sensor 40 and A/D converter 48 and the control function of an electronic control 28.

[0055] In drawing 6 , the change value calculation means 76 computes change value ΔBP of the blood-pressure value BP determined by the blood-pressure-measurement means 60. Here, change value ΔBP is the rate of change (%) of the blood-pressure value BP. Or highest-blood-pressure value BPSYS which is variation (mmHg), for example, was measured by the blood-pressure-measurement means 60 last time Highest-blood-pressure value BPSYS measured by the blood-pressure-measurement means 60 this time receiving They are rate of change or variation.

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[0056] When judged with arrhythmia having generated the unusual judging means stage 78 by the aforementioned arrhythmic judging means 70, the blood-pressure-measurement means 60 and the change value calculation means 76 are performed, and change value ΔBP computed by the change value calculation means 76 judges with a patient's circulation condition being unusual based on having exceeded the criterion value TH (Δ) set up beforehand. In addition, an absolute value performs judgment whether this change value ΔBP exceeded the criterion value TH (Δ) as well as the above-mentioned unusual judging means 72. moreover, when the hypotensive signal from the aforementioned transfer switch 56 is supplied The blood-pressure value BP as which the unusual judging means 78 was determined by the blood-pressure-measurement means 60, And at least one side of change value ΔBP computed by the change value calculation means 76 based on the blood-pressure value BP judges with a patient's circulation condition being unusual based on having exceeded the criterion value TH (BP) beforehand set up about each, and TH (Δ). the blood-pressure value BP with which the criterion value TH about the blood-pressure value BP (BP) is used for a judgment -- highest-blood-pressure value BPSYS it is -- or -- whether it is the average blood-pressure value BPMEAN and lowest-blood-pressure value BPDIA it is -- although it changes with or -- highest-blood-pressure value BPSYS When used for a judgment, the criterion value TH (BP) is set as 80 - 90mmHg.

[0057] When it is judged with arrhythmia having occurred by the arrhythmic judging means 70 by the unusual judging means 78 according to the above-mentioned operation gestalt The blood-pressure value BP is measured by the blood-pressure-measurement means 60, change value ΔBP of the blood-pressure value BP is computed by the change value calculation means 76, and it judges that a circulation state is unusual further based on having exceeded the criterion value TH (Δ) to which the change value ΔBP was set beforehand. That is, since the abnormalities of a living body's circulation condition are judged based on arrhythmia and change of blood pressure, a circulation state is judged correctly.

[0058] moreover, when according to the above-mentioned operation gestalt the hypotensive patient signal was beforehand inputted from the transfer switch 56 and it is judged with arrhythmia having occurred By the unusual judging means 78, change value calculation means 76 The criterion value TH (Δ) to which at least one side of the blood-pressure value BP measured by change value ΔBP and the blood-pressure-measurement means 60 which were depended and computed was beforehand set about each, Since it judges that a circulation state is unusual based on having exceeded TH (BP), the abnormalities of a circulation state are judged more certainly.

[0059] next, the operation gestalt of further others of this invention -- explaining . Drawing 7 is a functional block diagram explaining the important section of the control function of the electronic control 28 in the circulation condition-monitoring equipment 80 with which this invention was applied. In addition, this circulation condition-monitoring equipment 80 has the same composition as the above-mentioned circulation condition-monitoring equipment 8 except the photoelectrical pulse wave sensor 40, A/D converter 48, electrocardio signal-detection equipment 50, the electrode 52, A/D converter 54, and the transfer switch 56 not being formed and the control function of an electronic control 28 differing from the above-mentioned circulation condition-monitoring equipment 8.

[0060] In drawing 7 , the pulse period determination means 82 controls an air pump 18 and a change-over valve 16. The compression pressure force of a cuff 10 is controlled to the pressure (for example, 20 - 30mmHg) fully beforehand set as the low value rather than the lowest-blood-pressure value. A pressure sensor 14 and the pulse wave discriminator 24 detect the brachial-artery wave transmitted to a cuff 10 from the brachial artery which is not illustrated in the state, and it is based on the predetermined part (for example, a standup point or a peak) of the detected brachial-artery wave, and is the pulse period TP. It determines. Since a brachial artery wave is besides a heartbeat synchronization voltage, a cuff 10, a pressure sensor 14, and the girdle pulse wave discriminator 24 function as heartbeat synchronization-voltage detection equipment.

[0061] The arrhythmic judging means 84 judges arrhythmia based on the pulse period TP determined by the pulse period determination means 82. That is, this arrhythmic judging means 84 is the pulse wave period TP among arrhythmia. It is based and the arrhythmic chisel which can be judged is judged. As

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arrhythmia which can be judged based on the pulse period TP, there are a bradycardia, tachycardia, ***** , premature contraction, auricular fibrillation, etc.

[0062] The 1st abnormality judging means 86 is the 1st criteria blood-pressure value BP1 to which the blood-pressure value BP measured by the blood-pressure-measurement means 60 was set beforehand. Based on being the following, it judges with a patient's circulation condition being unusual. the above-mentioned 1st criteria blood-pressure value BP1 the blood-pressure value BP judged -- highest-blood-pressure value BPSYS it is -- or -- or it is the average blood-pressure value BPMEAN -- lowest-blood-pressure value BPDIA the blood-pressure value BP judged although it differs -- highest-blood-pressure value BPSYS it is -- a case -- the above-mentioned 1st criteria blood-pressure value BP1 For example, it is set as 70mmHg(s).

[0063] The 2nd abnormality judging means 88 is the 2nd criteria blood-pressure value BP2 to which the blood-pressure value BP which performed the blood-pressure-measurement means 60 and was determined by the blood-pressure-measurement means 60 when judged with arrhythmia having occurred by the aforementioned arrhythmic judging means 84 was set beforehand. Based on being the following, it judges with a patient's circulation condition being unusual. the above-mentioned 2nd criteria blood-pressure value BP2 The aforementioned 1st criteria blood-pressure value BP1 it is set as a value large about 5-30 mmHgs -- having -- moreover, the aforementioned 1st criteria blood-pressure value BP1 the blood-pressure value BP judged similarly -- highest-blood-pressure value BPSYS it is -- or -- or it is the average blood-pressure value BPMEAN -- lowest-blood-pressure value BPDIA It differs.

[0064] the unusual display means 90 -- the [above-mentioned] -- the [1 unusual judging means 86 or] -- when it judges that a patient's circulation condition is unusual by 2 unusual judging means 88, a display to that effect is displayed on a drop 36

[0065] Drawing 8 is a flow chart which explains still more concretely the important section of a control operation of the above-mentioned electronic control 28 in circulation condition-monitoring equipment 80. First, the initial processing which clears Timer t and a register in SC1 is execution *****.

[0066] In continuing SC2, it is judged based on Timer t whether the blood-pressure-measurement starting period which is 15 to which the elapsed time after blood pressure measurement by the cuff 10 is performed last time was set beforehand, or about 20 minutes was passed. When judgment of this SC2 is affirmed, the blood-pressure value BP is measured using a cuff 10 by performing a blood-pressure-measurement routine in SC3 corresponding to the continuing blood-pressure-measurement means 60. This blood-pressure-measurement routine is the same processing as SA2, SA4-SA8 of above-mentioned drawing 4 .

[0067] Highest-blood-pressure value BPSYS measured by the above SC 3 in SC4 corresponding to the continuing 1st abnormality judging means 86 The 1st criteria blood-pressure value BP1 It is judged whether they are 70 or less mmHgs which were set up by carrying out. When this judgment is denied, the one or less above-mentioned SC is performed repeatedly. On the other hand, when affirmed, SC13 mentioned later is performed.

[0068] When judgment of the above SC 2 is denied (i.e., when the blood-pressure-measurement starting period has not yet passed), after "1" is added to the content of Timer t, in continuing SC5, SC6 or SC9 corresponding to the pulse period determination means 82 is performed.

[0069] First, in SC6, by controlling an air pump 18 and a pressure control valve 16, the compression pressure force of a cuff 10 is made into the low voltage of 20 - 30mmHg, and the pressure is maintained. Cuff pulse wave signal SM 1 which was detected by the pressure sensor 14 in the state, and was further detected by the pulse wave discriminator 24 in continuing SC7 That is, a brachial-artery wave is read.

[0070] In continuing SC8, it sets to the above SC 7, and is the cuff pulse wave signal SM 1. It is judged whether it was read by one beat. It is the cuff pulse wave signal SM 1 by performing seven or less above SC repeatedly, while judgment of this SC8 is denied. Although reading is continued In SC9 corresponding to the pulse period determination means 82 which continues when affirmed Cuff pulse wave signal SM 1 read by the repeat of the above [SC / SC and / 8] 7 The predetermined part (for example, peak) of the brachial-artery wave to express is determined, and it is the pulse period TP from the interval of the predetermined part. It is determined.

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[0071] Pulse period TP determined by the above SC 9 in SC10 corresponding to the continuing arrhythmic judging means 84 It is judged whether arrhythmia occurred based on change. When judgment of this SC10 is denied, the above SC 2 or subsequent ones is performed repeatedly. However, when judgment of the above SC 10 is affirmed, in SC11 corresponding to the continuing blood-pressure-measurement means 60, the same blood-pressure-measurement routine as above-mentioned SC3 is performed.

[0072] Highest-blood-pressure value BPSYS measured by the above SC 11 in SC12 corresponding to the continuing 2nd abnormality judging means 88 The 2nd criteria blood-pressure value BP2 It is judged whether they are 80 or less mmHgs which carried out and were set up beforehand. When judgment of this SC12 is denied, the above SC 2 or subsequent ones is performed repeatedly.

[0073] On the other hand, when judgment of the above SC 12 is affirmed, or when judgment of the above SC 4 is affirmed, after the purport that a circulation state is unusual is indicated to a drop 36, this routine is terminated in SC13 corresponding to the continuing unusual display means 90.

[0074] Highest-blood-pressure value BPSYS which was measured by the 1st abnormality judging means 86 (SC4) by the blood-pressure-measurement means 60 (SC3) according to the above-mentioned operation gestalt The 1st criteria blood-pressure value BP1 set up beforehand When it is the following, the abnormalities of a living body's circulation condition are judged. When the abnormalities of a circulation state are not judged by the 1st abnormality judging means 86 (SC4), moreover, by the 2nd abnormality judging means 88 (SC12) When judged with arrhythmia having occurred by the arrhythmic judging means 84 (SC10) It is the highest-blood-pressure value BPSYS by the blood-pressure-measurement means 60 (SC11). It is measured. The highest-blood-pressure value BPSYS The 1st criteria blood-pressure value BP1 The 2nd criteria blood-pressure value BP2 beforehand set as the large value Since the abnormalities of a living body's circulation condition are judged when it is the following, the abnormalities of a circulation state are judged correctly.

[0075] Moreover, according to this operation form, since an overarm artery wave (heartbeat synchronous wave) is detected using the cuff 10 for blood pressure measurement, composition becomes easy and circulation condition-monitoring equipment 80 becomes cheap.

[0076] next, the operation form of further others of this invention -- explaining . Drawing 9 is a functional block diagram explaining the important section of the control function of the electronic control 28 in the circulation condition-monitoring equipment 92 with which this invention was applied. In addition, this circulation condition-monitoring equipment 92 has the same composition as the above-mentioned circulation condition-monitoring equipment 8 except the transfer switch's 56 not being formed and the control function of an electronic control 28 differing from the above-mentioned circulation condition-monitoring equipment 8.

[0077] It is the 2nd criteria blood-pressure value BP2 to which the presumed blood-pressure value EBP computed by the aforementioned presumed blood-pressure value calculation means 64 when it was judged with the irregular pulse having generated the 2nd abnormality judging means 94 by the aforementioned arrhythmic judging means 70 in drawing 9 and was judged with the irregular pulse having occurred was set beforehand. Based on being the following, it judges with a patient's circulation condition being unusual. This 2nd criteria blood-pressure value BP2 It is the same as the value in the above-mentioned operation form. namely, the 2nd criteria blood-pressure value BP2 The aforementioned 1st criteria blood-pressure value BP1 it is set as a value large about 5-30 mmHgs -- having -- moreover, the aforementioned 1st criteria blood-pressure value BP1 the blood-pressure value BP judged similarly -- highest-blood-pressure value BPSYS it is -- or -- or it is the average blood-pressure value BPMEAN -- lowest-blood-pressure value BPDIA It differs.

[0078] The 1st criteria blood-pressure value BP1 to which the blood-pressure value BP measured by the blood-pressure-measurement means 60 was beforehand set by the 1st abnormality judging means 86 according to the above-mentioned operation form The abnormalities of a living body's circulation condition are judged based on being the following. When the abnormalities of a circulation state are not judged by the 1st abnormality judging means 86, moreover, by the 2nd abnormality judging means 94 It is judged with the irregular pulse having occurred by the arrhythmic judging means 70. The presumed

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blood-pressure value EBP computed by the presumed blood-pressure value calculation means 64 is the aforementioned 1st criteria blood-pressure value BP1. The 2nd criteria blood-pressure value BP2 beforehand set as the large value Since it judges that a circulation state is unusual based on being the following, a circulation state is judged correctly. In addition, since pulse wave propagation velocity information is determined by the photoelectrical pulse wave sensor 40 and electrocardio signal-detection equipment 50 based on the photoelectrical pulse wave and electrocardio guidance wave which were detected without ****(ing) a living body and the presumed blood-pressure value EBP is determined based on the pulse wave propagation velocity information, whenever it is judged with the irregular pulse having occurred, un-arranging [of ****(ing) some living bodies and giving a patient pain] is canceled. [0079] As mentioned above, although 1 operation form of this invention was explained in detail based on the drawing, this invention is applied also in other modes.

[0080] For example, although electrocardio wave detection equipment 50 was used as heartbeat synchronous wave detection equipment or the cuff 10, the pressure sensor 14, and the pulse wave discriminator 24 were used as heartbeat synchronous wave detection equipment with the above-mentioned operation form, since the pulse wave which spreads in the living body is a heartbeat synchronous wave, the pulse wave detection equipment which detects the pulse wave may be used as heartbeat synchronous wave detection equipment. That is, the impedance pulse wave detection equipment which detects impedance change through the above-mentioned photoelectrical pulse wave sensor 40, the photoelectrical pulse wave detection probe for oximeters, and the electrode with which the living body was equipped, the pressure pulse wave detection equipment which is pressed by ***** and the radial artery and detects the internal pressure may be used as heartbeat synchronous wave detection equipment. Moreover, since a heartbeat is also a heartbeat synchronous wave, the heartbeat detection equipment which detects a heartbeat may be used as heartbeat synchronous wave detection equipment.

[0081] Moreover, in the above-mentioned operation form, although pulse wave propagation velocity information was computed as blood-pressure related information, since the area S of the pulse wave measured by the aforementioned photoelectrical pulse wave sensor 40 grade is changed in relation to blood pressure, the normalization pulse wave area VR which normalized the area S and its area S of a pulse wave based on one period W and amplitude L of the pulse wave may be computed as blood-pressure related information. Moreover, cardiac cycle TP Since it reaches and a heart rate HR relates to blood pressure, they are these cardiac cycles TP. And a heart rate HR may be used as blood-pressure related information.

[0082] Moreover, although the purport that a circulation state was unusual was indicated to the drop 36 by the unusual display meanses 74 and 90 with the above-mentioned operation form when the abnormalities of a circulation state were judged, it may replace with the display or an alarm tone may be generated with the display.

[0083] Moreover, with the 1st above-mentioned operation form, although the unusual judging means 72 was performing blood pressure measurement by the blood-pressure-measurement means 60 when the abnormalities of a circulation state were judged, blood pressure measurement by this blood-pressure-measurement means 60 does not need to be performed.

[0084] In addition, in addition to this in the range in which this invention does not deviate from the main point, various change may be added.

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